

TO: Jacqueline Williams
Purchasing Manager

DATE: June 2, 2014

FROM: Raymond A. Weeden
Director of Operation
and Maintenance

RE: **Addendum No. 1**

Support Services for Automation
SSA-1

Please issue **Addendum No. 1** to the Attendees of the Mandatory Pre-Proposal Meeting.

A pre-proposal meeting was held on May 29, 2014 at the George J. McMonagle Building of the Northeast Ohio Regional Sewer District (NEORS D) located at 3900 Euclid Ave., Cleveland, OH. A list of attendees who signed in at the meeting is included as Attachment 1. The meeting convened at 1:00 PM, with the Douglas Mackie, Project Manager, introducing himself and the following individuals:

Scott Sander	NEORS D, Engineer
Diana Jones	NEORS D, Certification Officer
Elizabeth Biggins-Ramer	NEORS D, Contract Project Coord.

It was stated that any answers or statements given during the meeting are not official. The written addendum will be the official response.

This Addendum can be downloaded from the District Sharefile website at:
<https://neorsd.sharefile.com/i/i877274b1df34bc08>

Item 1

Please **replace page 14** wording under section 4.3.1, titled *Experience of Key Team Members on Similar Projects*, in the second paragraph, which has been modified to read as follows:

Key Consultant staff include but are not limited to project manager, technical discipline leads, design manager, design engineer, ~~resident construction representative,~~ and other key staff on the top or mid levels of the proposed organization chart.

Item 2

Please **replace Attachment E in its entirety** with the revised attached document.

QUESTIONS AND COMMENTS

The meeting was opened to questions from the attendees. The following are the questions asked at the meeting and answers to those questions:

Q1 – For the addendum, should there be any substantial changes in task, budget, schedule, or time frames?

A1 – Nothing significant anticipated; see addendum for details.

Q2 – The RFP lists “other services as negotiated by the District and Consultants”. Does this allow for any extension outside of the contract’s current limits?

A2 – No, the intent of this statement is to negotiate differing task types or scopes if required. It does not affect cost or duration.

Q3 - A cost-loaded MS-Project, not Primavera, schedule is required. Is this correct?

A3 – This is an Operations contract, and maintaining a Primavera project schedule is not required. A cost-loaded MS-Project schedule is required.

Q4 – Similarly, are the normal “Sharepoint” workflow and invoicing processes required?

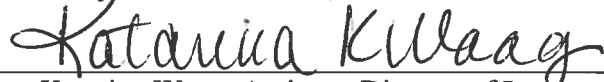
A4 – As noted, this is an Operations contract, and we will not be using all of Engineering’s workflow practices.

APPROVED FOR TECHNICAL CONTENT:



Raymond A. Weeden, Director of O& M

APPROVED FOR LEGAL CONTENT:



Katarina Waag, Assistant Director of Law

cc: R. Czerski D. Mackie K. Waag T. Jordan R. Lowery

NEORS D Support Services for Automation, SSA-1
Operations - Process Control and Automation

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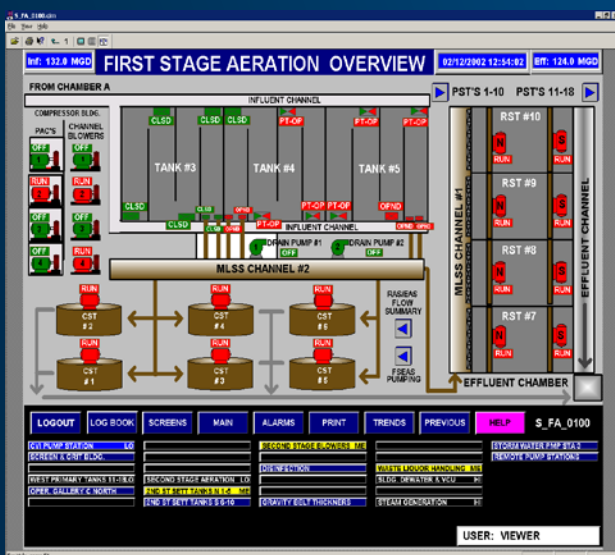
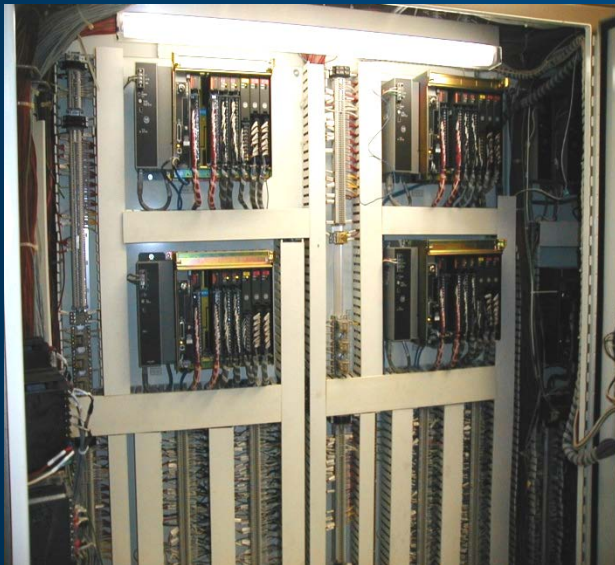
**Northeast Ohio
Regional Sewer District**



NEORS AUTOMATION STANDARDS AND CONVENTIONS MANUAL

Revision 2.0.1

Date: June 2, 2014



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Revision History

Revision	Revision Date	Author	Updated Section	Description
0.0.0	24-Nov-2010	PSIM	All	Compiled all individual standard documents into this single document. Removed Loop spreadsheets; using a hyperlink.
0.0.0	24-Nov-2010	PSIM	Part I Section 3	Added Deviation Request
0.0.0	24-Nov-2010	PSIM	Part II Section 1.9	Updated for new naming convention
0.0.0	24-Nov-2010	PSIM	Part IV Section 7	Added Process Abbreviations List
0.0.0	24-Nov-2010	PSIM	Part V	Added new sections for Wonderware and ControlLogix and PanelView programming
0.0.1	02-Dec-2010	PSIM	Part V	Minor changes to CLX/WW standard
0.0.1	02-Dec-2010	PSIM	Part V Section 3.12	Added Control Modes description
1.0.0	15-Dec-2010	PSIM	All	Updates and clarifications to multiple sections. Includes 12/6/10 workshop comments.
1.1.0	20-Jan-2011	PSIM	Part V Section 2.4, 2.7, 2.9, 2.10, 2.11	Clarification on WW platform.
1.2.0	02-Mar-2011	PSIM	Part II Section 9	Corrected section numbering.
1.2.0	02-Mar-2011	PSIM	Part II Section 1.9	Clarified use of Train & Parallel fields
1.2.0	02-Mar-2011	PSIM	Part V Section 3.4, 3.8, 3.11	Message routing, Referenced Discrete AOI, Referenced PLC _Status AOI
1.2.0	02-Mar-2011	PSIM	Part V Section 4.3, 4.4, 4.6, 4.7, 4.8, 4.4E	Application and Display Naming, Alarms, Trends, Default Security, Key Assignments
1.2.0	02-Mar-2011	PSIM	Part IV, Section 7	Added more abbreviations to tables
1.2.0	02-Mar-2011	PSIM	Part V Section 2.7, 2.6.D	Updates and clarifications to all sub sections, added deadband logging
1.2.0	02-Mar-2011	PSIM	Part II Section 2.2, 2.4D, 2.4E	Added requirement for conformal coating to PLC components and relays
1.3.0	31-May-2011	PSIM	Part II Section 7	Added additional abbreviations
1.3.0	31-May-2011	PSIM	Part IV Section 1.1	Updated CLX wire tagging convention.
1.3.0	12-Jun-2011	PSIM	Part V Section 2.10.F	Revised WW graphic naming.
1.3.0	15-Jun-2011	PSIM	Part V Section 3.8D, 3.8H, 3.11D, 4.10	Clarified analog IO mapping, Digital IO mapping, removed HMI button desc, updated diagnostics.
1.3.1	16-Jun-2011	PSIM	All	Updated revision in footer, added date and revision to cover.
1.4.0	01-Jan-2012	PSIM	Part II Section 7	Added additional abbreviations
1.4.0	20-Jan-2012	PSIM	Part II Section 3.5	Added PLC5 rounding/truncation logic standard
1.4.0	24-Jan-2012	PSIM	Part V Section 3.11.I	Added alarm horn and light acknowledgement scheme
1.4.0	24-Jan-2012	PSIM	Part V Section 2.7.J.7	Updated naming convention (was J.13)
1.4.0	24-Jan-2012	PSIM	Part V Section 2.11.E and 4.4.C	Added additional process pipe colors
1.4.0	24-Jan-2012	PSIM	Part V Section 2.7.Q.4	Added details on screen object areas
1.4.0	24-Jan-2012	PSIM	Part II Section 2.2.F	Changed PanelViews to 120VAC with conformal coating
1.4.0	24-Jan-2012	PSIM	Part V Section 2.14.A.2	Added details on window scripts

Revision	Revision Date	Author	Updated Section	Description
1.4.0	24-Jan-2012	PSIM	Part II Section 1.9.F	Updated examples to reflect current standard
1.4.0	24-Jan-2012	PSIM	Part V Section 2.13.A.1	Corrected window properties
1.4.0	24-Jan-2012	PSIM	Part V Section 3.2	Updated to include PLC file name
1.4.0	24-Jan-2012	PSIM	Part V Section 3.3.C	Updated module naming convention
1.4.0	24-Jan-2012	PSIM	Part V Section 3.6.F	Changed the default rate for Misc Logic
1.4.0	27-Feb-2012	PSIM	Part V Section 3.10	Updated CLX messaging standard
1.4.0	05-Mar-2012	PSIM	Part II Section 2.2.F	Update OIT specifications
1.4.0	05-Mar-2012	PSIM	Part II Section 2.4.F	Changed Stop PB to extended style
1.4.0	19-Mar-2012	PSIM	Part II Section 7	Removed Electrical standards; maintained separately
1.4.1	02-Apr-2012	PSIM	Part II Section 1.5	Added RS for Riverbed Street remote site
1.4.1	02-Apr-2012	PSIM	Part II Section 7	Added section 7.0 so info is show in table of contents
1.5.0	12-Jul-2012	PSIM	Part II Section 1.9	Removed attribute from examples; added new subsection
1.5.0	12-Jul-2012	PSIM	Part II Sec 2.2.B,C,D,E,F	Updated Rockwell PLC, OIT and power supply details
1.5.0	05-Nov-2012	PSIM	Part II Sec 2.2	Added the conformal coating requirement
1.5.0	05-Nov-2012	PSIM	Part V Sec 2.4.A	Clarified default operator access allows set point changes
1.5.0	05-Nov-2012	PSIM	Part V Sec 2.2,2.4,2.5,2.9	Updated assorted WW details
1.5.0	07-Dec-2012	PSIM	Part V Sec 2.2.G, 2.2.H	Added Instance naming details
1.5.0	07-Dec-2012	PSIM	Part V Section 5	Added DeviceLogix standards
1.5.0	07-Jan-2013	PSIM	Part V Sec 2.8, 3.5, 3.13	Clarified AOI/UDT usage
1.5.1	08-Feb-2013	PSIM	Part IV	Removed erroneous blank sections
1.6.0	12-Jun-2013	PSIM	Part V	Assorted updates per the PC&A workshop action items
1.6.1	22-Aug-2013	PJM	Part II, Section 2.2.F	Updated OIT specifications to include Notes to Specifier, added 15 inch display, eliminated distinction between wastewater plants and collection system, added keypad/touch screen combination and extended features.
1.6.1	22-Aug-2013	PJM	Various sections	For clarity and consistency with Part II, Section 2.2.F, references to “PV Plus” and “PanelView Plus” were updated to “PV Plus 6” and “PanelView Plus 6”, respectively. Additionally, any generic references to “PV” or “PanelView” are also intended to mean the “PanelView Plus 6” or current series of Allen-Bradley OIT. Did not change “Last Edited” section date except for Part II, Section 2.2.F where the PanelViews are specified.
1.6.1	22-Aug-2013	PJM	Part V, Section 4.2.A	Updated OIT requirement to PanelViews with keypad and touch screen.
1.6.1	22-Aug-2013	PJM	Part II, Section 2.2.A and 2.2.B titles	After “Allen-Bradley PLC-5” and “Rockwell SLC-500 Series” titles added “(No Longer Specified for New Construction)”
1.6.1	22-Aug-2013	PJM	Part II, Section 2.2.C-E.1 and 2.2.C-E.2	Updated Allen-Bradley ControlLogix “removable terminal block housings” to “ extended depth removable terminal block housings”
1.6.1	22-Aug-2013	PJM	Part II, Section 2.2.D-D.3.c.1)	Fixed typo in 1492-IFM20F model number.
1.6.1	22-Aug-2013	PJM	Part II, Section 2.2.D-D.3.c.2)	Added 1492-IFM40F module.

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Revision	Revision Date	Author	Updated Section	Description

Revision Format: X.Y.Z

- X = Major modifications to any section of the document. These types of changes effect functionality or operation of a process. Adding or deleting sections also constitutes a major change. This level of change requires a review and approval by subject matter experts.
- Y = Intermediate modification to any section of the document. Typically a clarification to an existing section. This level of change requires a review and approval by subject matter experts.
- Z = Minor change to a proposed revision. Example: 1.1.0 is submitted for review, and a spelling error is caught. The document is revised up to 1.1.1 and continued through the review cycle. It is not necessary to go back to previous subject matter experts for a second review.

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Part I BACKGROUND

SECTION 1 - OVERVIEW

The Northeast Ohio Regional Sewer District (NEORS, or the District) is a political subdivision of the State of Ohio. It was established to provide services for collection, conveyance and treatment of wastewater for most of the greater Cleveland Metropolitan Area. The service area encompasses the City of Cleveland and all or portions of 61 suburban municipalities in Cuyahoga, Summit, Lake and Lorain Counties and includes service to a diversified group of manufacturing and processing industries.

The mission of the District is to provide effective wastewater and stormwater management that protects the health and environment of the region while enhancing quality of life. Since its creation, the District has planned, designed, constructed, operated, and maintained wastewater collection and wastewater treatment facilities and assets throughout its service area.

The District operates three wastewater treatment plants; the Southerly Wastewater Treatment Center, Easterly Wastewater Treatment Plant and Westerly Wastewater Treatment Center, and an extensive wastewater collection system that conveys wastewater and stormwater to the treatment plants. Through the operation of these plants and controlled use of wastewater storage capacity in the collection system, the District protects public health and enhances the water quality of Lake Erie and the Cuyahoga River.

Widespread application of instrumentation and process automation is an essential aspect of improving the efficiency and effectiveness of the District's operations. The District's continuing process automation initiative aims at providing an integrated, state-of-the-art, process monitoring and control system. The District has established the Process Control and Automation (PC&A) Department to provide expertise and services to maintain and manage the process control and automation system. The PC&A and Engineering & Construction Departments have established design, configuration and implementation standards to enable the District to manage the overall uniformity, compatibility and quality of control system hardware, software, instrumentation, communications and documentation.

SECTION 2 - PURPOSE OF THIS MANUAL

Wherever possible, process control system design, implementation and components, including hardware, software, communications, programming, and supporting mechanical and electrical design and equipment must adhere to NEORS standards. Standardization provides a number of benefits including improved buying power, reduced spare parts inventory, easier/reduced training requirements, better overall performance, and uniform operation and maintenance

As part of the overall effort to achieve consistent, compatible, and reliable implementation of instrumentation and control systems throughout the District's wastewater collection and treatment facilities, the District has developed this *NEORS Automation Standards and Conventions Manual*, and has also compiled a collection of instrumentation and control templates, guidelines, design standards, and standard specifications. These documents are based on best practices and examples of successful system development under various District projects.

Content is continuously being added and updated in an effort to maintain and up-to-date and expanding library of Process Control and Automation Standards.

The District's goal is to ultimately have a complete set of standards that are accessible to those that need them for carrying out District instrumentation, control and automation system work.

In-house designers and technicians, design consultants, system integrators and constructors are expected to incorporate and follow the standards when creating, deploying and/or upgrading all aspects of the District-wide process control and automation system. Process control and automation standards are to be applied when designing or implementing changes or additions to control and monitoring of the connected process equipment or to the process control and automation system itself.

One of the District's most important goals is to ensure all control processors and operator interfaces conform to a common product platform, and in doing so produce control logic, databases, reports, displays and other system components that are fully aligned with the needs of the District's current facilities and operations. Copying or transferring control logic and other programming from the existing system will not be acceptable unless specifically required by contract specifications. The standards included in this manual as well as the District's other design standards must be adhered to in developing, programming and documenting control strategies and other system features.

SECTION 3 - STANDARDS DEVIATION REQUEST

Section – 3.0 - General

The NEORSD Automation Standards and Conventions are intended to provide consistent, reliable controls within all plants. However, it is recognized that there may be specific instances in which a contractor or supplier may not be able to fully comply with the standards for software, equipment, cabling and other control system components supplied or developed under a contract or other procurement method, or may not be able to program or configure the system in conformance with these standards. When these cases arise, the contractor or supplier must submit a request for deviation from NEORSD Standards using the NEORSD Standards Deviation Request Form included in this section. The District will review the issues documented on the form and any supplemental documentation that is supplied with the request, and if compelling reasons are presented, the District may grant the deviation. The Standards Deviation Request must meet the following criteria:

1. It must clearly indicate those sections of the standards that are relevant to the proposed deviation(s)
2. It must verify that compliance with the standards from which the deviation(s) is requested is, under the circumstances, not feasible
3. It must explain how the deviation(s) meets the fundamental intent of the Standards and the project requirements
4. It must include a specific description of the proposed alternative to the requirements in the NEORSD Standards and include supporting documentation. Documentation may include references demonstrating successful use by other public utilities
5. It must show that such deviations are not contrary to the public interest, health and safety

6. It must verify that the deviation(s) will not compromise safety, functionality, public health, esthetics, and maintainability
7. It must verify that all applicable codes will be met.

Section – 3.1 - Procedure

The process to request a deviation from the NEORSD Automation Standards and Conventions is as follows:

1. Fill out and submit the NEORSD Standards Deviation Request Form. The form must be filled out electronically and submitted via e-mail to the designated NEORSD Project Manager or other designated contact. NEORSD will supply the blank electronic form on request. A copy of the form is included in this section.
2. Transmit supporting documentation, such as drawings, mark-ups, photographs, sketches, vendor-supplied product information, etc. with the Deviation Request e-mail. If attachments exceed mailbox limits then submission should occur via CD-ROM or other means of sharing large files.
3. Additional information may be requested by the District and/or an alternative solution(s) presented by the requester. A meeting may be requested by the deviation requester to explain the issues to the District Project Manager and project team members.
4. NEORSD Staff review of the Standards Deviation Request will result in the District assigning one of the following statuses:

Accepted – If the requested deviation is acceptable to the District, NEORSD will notify the requester in writing and will note any limitations placed on the allowable deviation.

Rejected – If the requested deviation is rejected the District will notify the requester in writing and the work must proceed without delay in accordance with the Contract or other pertinent procurement requirements.

The District will return a written decision within 10 working days under normal circumstances. However, complex issues may require additional time for analysis and preparation of a response. The District will work with the requester if further explanation or discussion is needed to reach a timely decision.

5. Appeals of the District's decision shall be submitted within ten (10) calendar days of the date of the decision and shall be submitted in writing to the District's Project Manager.

NEORSD Standards Deviation Request Form

Northeast Ohio Regional Sewer District 3900 Euclid Ave. Cleveland, OH 44115 216-881-6600

Date of Request: _____ Project Number: _____
Name of Requester: _____ Name of Firm: _____
Phone No.: _____ E-mail address: _____

Attach additional sheets as needed to provide the information required below:

Standards(s) for which a deviation is requested (list document name, section(s), subsection(s):

Fully explain reason for deviation request:

Proposed alternative implementation:

Supporting documentation attached? Yes ☐ No ☐

Signing below indicates that the Requestor has verified compliance with the requirements of the
Standards Deviation Request procedure included in the *NEORSD Automation Standards and Conventions Manual*

Requester's Signature

Date

THIS AREA FOR NEORSD USE ONLY

Date Received: _____

Date Returned: _____

Reviewed by: _____

Authorized NEORSD Signature

District Decision: Accepted ☐ Rejected ☐

Comments/Limitations:

Part II Standards and Conventions

SECTION 1 - HMI STANDARDS AND CONVENTIONS

Section 1.0 - Introduction

This section contains standards for process screens as developed for the Northeast Ohio Regional Sewer District's Plant Automation System. These screens allow plant operators to monitor and control field equipment from Area Control Stations (ACSs) located throughout the plant.

Process screens contain several elements that have been standardized during their initial development. One element is the interface window or template that surrounds process equipment on each screen. Other elements include symbols that represent field equipment such as pumps, valves and motors.

Section 1.1 - Process Symbols and Color Conventions

Standards for symbols and colors have been developed to display information on the status of field equipment and processes. This is to aid operators in interpreting information displayed on process screens.

Figure II.1.1.1 illustrates the standard colors developed for process piping. Piping is color coded to indicate material contained within. Process piping is either drawn, using lines with a width of 5 points or 11 points, depending on the relative sizes of lines and what is appropriate to the layout of equipment on a process screen.

Some pieces of equipment are represented using only static structures. Symbols for these types of equipment are shown in Figure II.1.1.2. Elements of these objects do not change as conditions in the plant, process, or equipment change. They have been included as a point of reference to operators to help define the location of other pieces of equipment in a process.

The vast majority of equipment, however, is represented on process screens with symbols or combinations of symbols whose appearance changes as conditions or equipment in the plant or process change. These symbols are shown in Figure II.1.1.3 through Figure II.1.1.5.

Symbols representing more generic equipment or types of equipment that are more often encountered are shown in Figure II.1.1.3. Each of these symbols changes color to indicate equipment status. Red indicates that a piece of equipment is running or a valve or gate is fully opened. Green indicates that a piece of equipment is off or a valve or gate is fully closed. Yellow indicates that a piece of equipment is malfunctioning. Black indicates that information is not available from the HMI process server.

These symbols also allow an operator to send commands to equipment. More will be said on how commands are sent to equipment in Section II.1.6 – *Process Control*.

Figure II.1.1.4 shows other symbols that change as plant or process conditions change. These symbols contain text describing the state of a piece of equipment. Symbols at the far left side of the figure are the objects used to build process graphics. These are points appropriate for pumps, motors, etc.

Figure II.1.1.5 shows a text symbol appropriate for valves and gates. The yellow “Alarm Text Boxes” are normally not visible on an active screen. However, when an alarm condition arises, the box becomes visible to notify the operator. The red “Status Text Boxes” appear when an event or non-alarm process condition occurs.

“Analog Level Indicators” convey analog (continuously variable values) such as speed, level, flow, etc. The “Analog Set point Box” allows an operator to enter numerical values such as Setpoints to controllers.

Section 1.2 - Standard Cimplicity Screen Templates

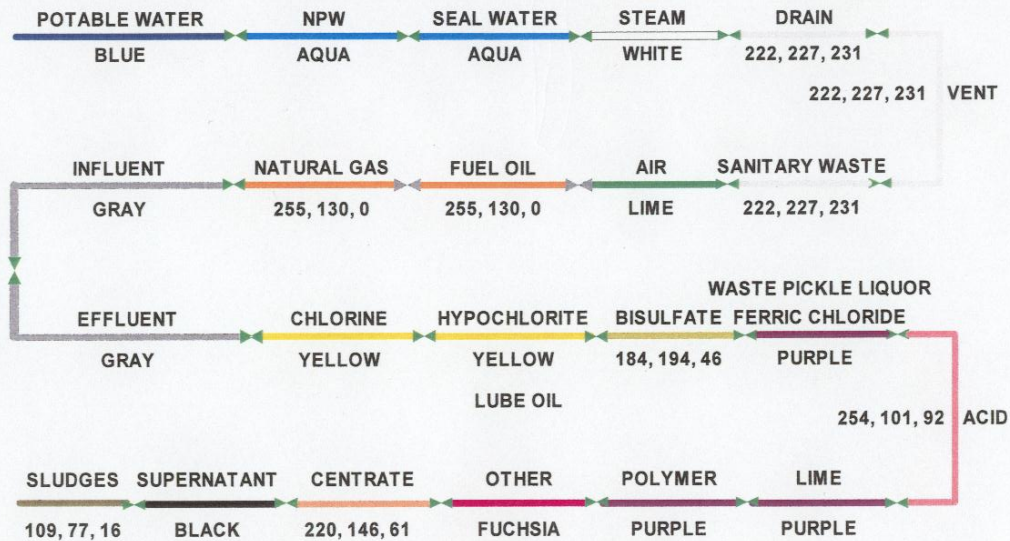


Figure II.1.1.1: Standard Process Colors

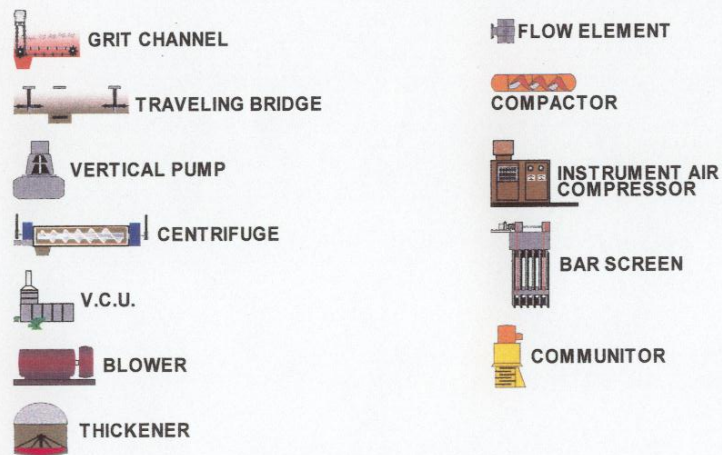


Figure II.1.1.2: Standard Static Process Symbols

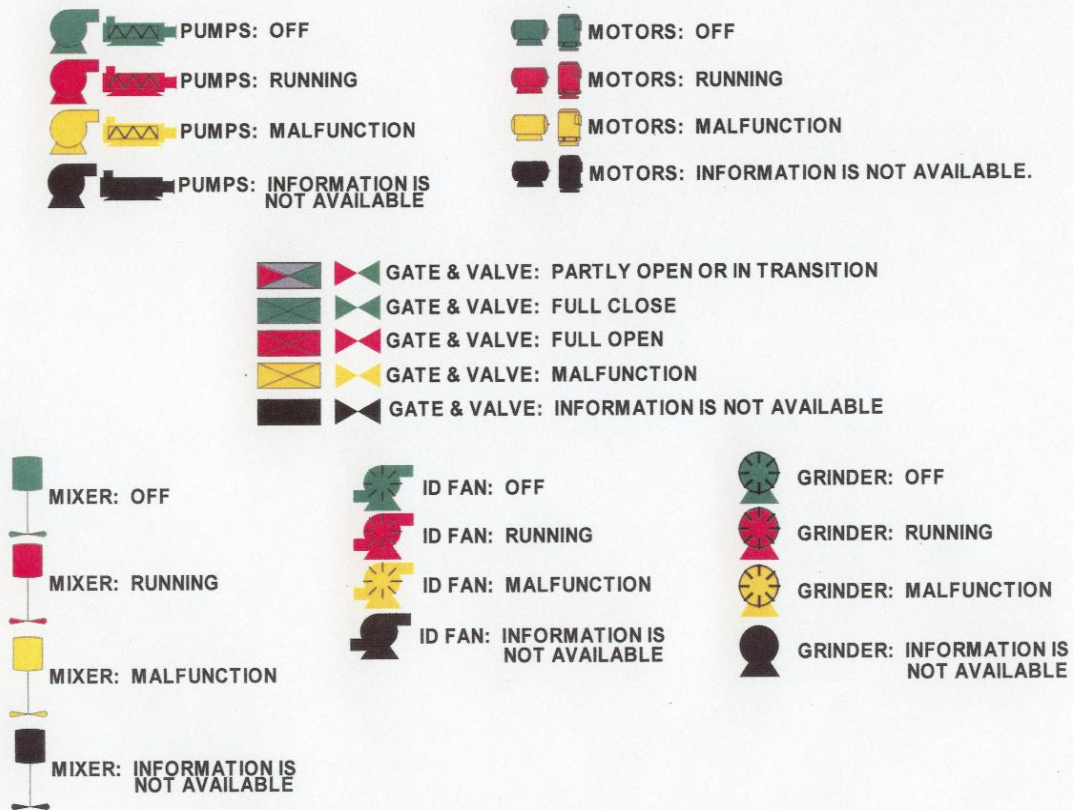


Figure II.1.1.3: Standard Dynamic Process Equipment Symbols

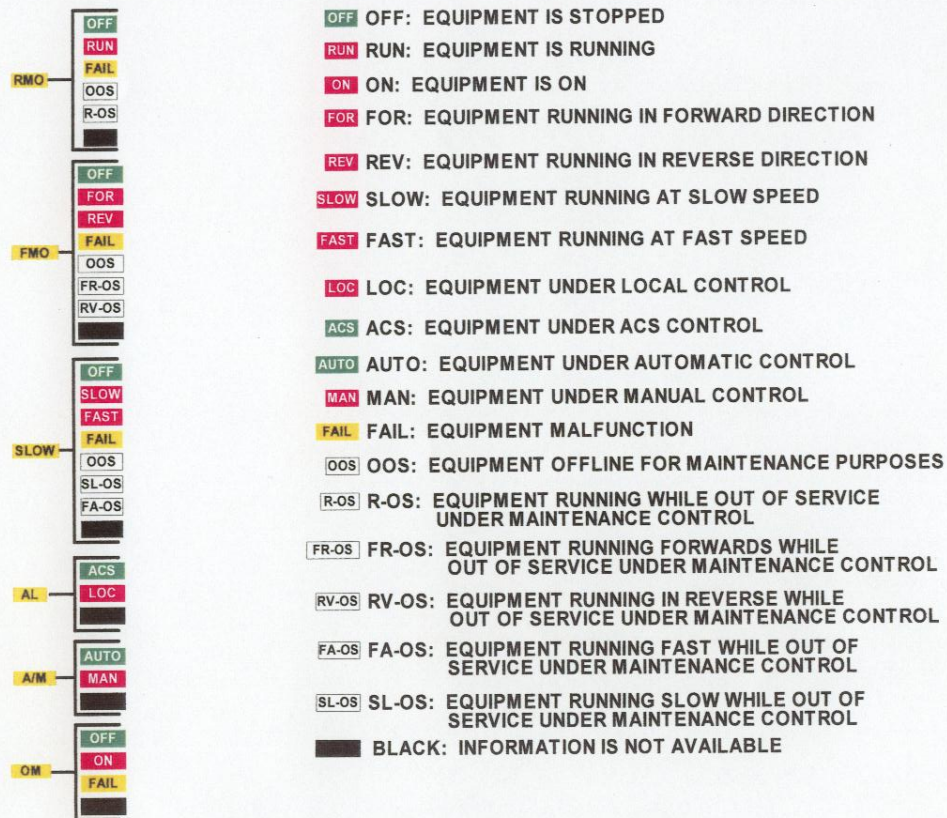


Figure II.1.1.4: Standard Dynamic Text Symbols

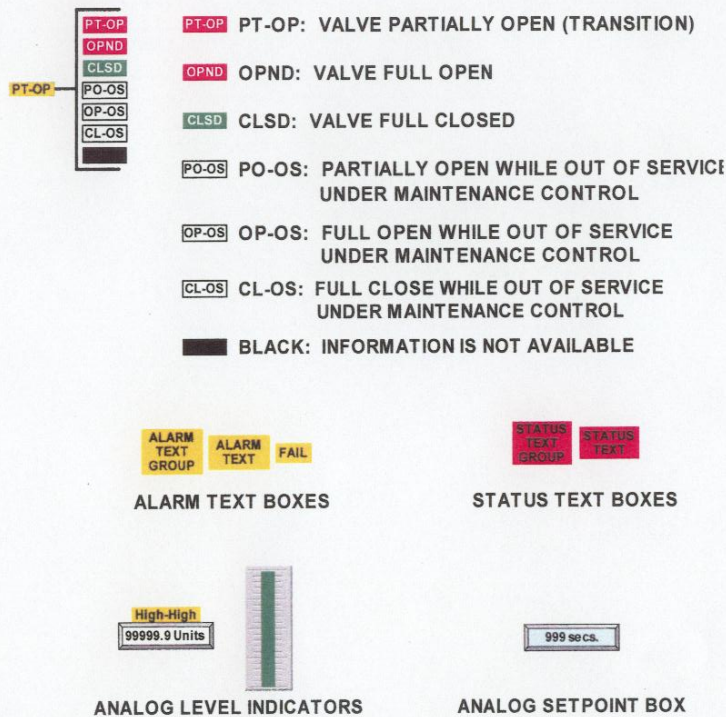


Figure II.1.1.5: Standard Dynamic Process Text Symbols, Alarm Symbols, Status Symbols, Analog Indicator Symbols and Analog Setpoint Symbols

Other conventions include:

System Mode – Local mode is black text on green, Remote mode is black text on red.

Bypass Mode – Normal operation (not bypassed) will be black text on green or invisible altogether, Bypassed will be black text on red.

System Status – Represented with a multistate text box. Normal “ok to start” is black text on green; all others (no permissive, standby, etc) are black text on red.

Section 1.3 - Alarm Priorities

Currently, alarms are prioritized according to the four categories shown below.

- Priority 1: Health and Human Safety Alarms (Chlorine High Level, Explosive Gas High Level, etc.)
- Priority 2: Conditions that indicate, result in, or may lead to, regulatory permit violations (e.g. loss of control, loss of signals, chemical addition problems, water quality sensor alarms, and other alarms associated with regulated parameters and processes).
- Priority 3: Process variable excursions ("high" and "low" levels), non-catastrophic machine failures and computer network failures.
- Priority 4: Failover from primary to redundant units (e.g. one of a pair of redundant processors or communication links failing) or other miscellaneous non-process failures.

Priority 4 alarms are only displayed on alarm pages when a person with the privileges of a system administrator is logged into the system. Operators will only see Priority 1, 2, or 3 alarms.

Section – 1.4 - Alarm Configuration

Alarms of different priorities are displayed on alarm summary pages using different colors to aid in their identification. Color coding for alarms is as shown in Table II.1.3.1 below.

Table II.1.3.1 - Alarm Color Configuration

	Unacknowledged alarms		Acknowledged Alarms		Reset Alarms	
Alarm Priority	Text/Fore-ground	Back-ground	Text/Fore-ground	Back-ground	Text/Fore-ground	Back-ground
1	White	Red	Red	White	White	Black
2	Black	Yellow	Yellow	Black	White	Black
3	White	Blue	Blue	White	White	Black
4	White	Green	Green	White	White	Black

Section 1.5 – Point Tag Naming Convention

1.5.A – Existing Process Loops for Easterly WWTC

1.5.B – Existing Process Loops for Westerly WWTC

1.5.C – Existing Process Loops for Southerly WWTC

1.5.D – Existing Process Loops for Remote Pump Stations

Section 1.6 - Process Control

In the Automation system, control functions shall be executed exclusively by Programmable Logic Controller (PLC) units. Logic for safety interlocks, equipment protection interlocks, start sequences, stop sequences, operational sequences, process and maintenance calculations (e.g., flow totalization, equipment run-time accumulators) shall also reside within PLCs. Local-Remote hardware switches on field equipment or panels, and HMI-based Auto-Manual software switches shall enable control via PLCs. The HMI system shall provide the capability for operators to start and stop equipment, select equipment for operation, select operating modes such as lead-lag and other options, change setpoints, manually adjust speed, position, temperature and other control parameters, and perform other control via interaction with PLCs. Control commands shall be sent by the HMI subsystem to PLCs which shall respond as commanded and control equipment. In general, Start-Stop, Open-Close, Auto-Manual, etc. commands shall be entered in the HMIs via a small popup window that overlays a process screen. Setpoints shall be modifiable via pop-up windows or via objects placed on process screens. However, this interaction shall be allowed only when security conditions have been satisfied. These conditions are based upon the following:

The “Role” of a User

Roles have been defined within the HMI subsystem to differentiate allowable levels of system access for each type of user. The default level of access, “VIEWER”, has no control of equipment. Only monitoring of processes and equipment is allowed.

Four other user roles have been defined. Two roles have been defined to differentiate areas of responsibility of on-site union personnel. These roles are the “2798OPER” operator (for Local 2798 personnel) and the “18OPER” operator (for Local 18 personnel). Users logged in to the system as a “2798OPER” may not control equipment whose area of responsibility belongs to Local 18 Union personnel and vice versa.

Two other roles have been created with higher levels of access. The “MANAGER” role for Shift Managers and Unit Process Managers (UPMs) may control all equipment. The “SYSADMIN” role for programmer and network administrators may also control all equipment. However, this is generally for testing and troubleshooting purposes.

Determining the “role” of a user shall be done at the HMI level via login procedures. The HMI shall prevent the transmission of control commands to PLCs by users attempting to control equipment inappropriate to their system role.

The Location of a User

Operations personnel at the Southerly Wastewater Treatment Center (SWTC) require operators to be in the vicinity of the equipment they operate via the HMI. Control functions at the SWTC shall be enabled at the HMI level based on the node name of the HMI station. Operations personnel at the nearest node(s) shall be able to control nearby equipment.

Section 1.7 - Process Control and Automation System Design Support Documentation

It is essential that the District have complete and accurate information describing the sources of process data monitored by the process control and automation system or by independent data acquisition systems or components. Designers that are undertaking projects that in any way involve data acquisition by the District's instrumentation and/or control systems shall produce, and incorporate in the design documents, supporting documentation describing in detail any computations, derivations, extrapolations, and other algorithms, that are used for design of process data acquisition and control elements. The supporting documentation must include all relevant details such as equations, constants, variables, exponents, Boolean expressions, time-based actions, scaling factors/conversions, performance computations, look-up tables, and other mathematical or logic operations. The documentation must provide references for the source of equations, tables and other algorithms that are used in the design. Examples may be orifice, weir, sluice, flume, and pipe flow equations, pump curves, venturi curves, and so on.

Generally the process control and automation system design record should include the determination of proper process variable spans, limits, and custom programmed operations executed by the process control and automation system involving more than one process variable. It does not include functions that are already built into the process control and automation system or those associated with the calculations and operations that are preconfigured in process instrumentation and electrical equipment such as flow transmitters, analytical instrumentation, and smart instrumentation/metering. Examples of design record items may include, but are not limited to:

- Process variable and equipment parameter spans and limits used in programmed logic
- Conversion of the measure of tank level into volumetric engineering units based on tank geometry
- Estimated time to fill or empty tanks calculated from valve position, pipe size, head, flow, or other factors
- Chemical dosage rate based on flow, demand, and chemical strength
- Wire-to-Water Efficiency for determining selection of best pump combinations.

The design record should identify applicable standards, engineering references, product documentation, and design factors from all engineering design disciplines that form the basis for calculations/equations, constants, scaling factors/ranges, and limits, and that validate the appropriate use/incorporation of these items in process control system programming logic, the generation of reports, and the collection of historical data. The process control and automation system design records should summarize design factors and constraints under which their application in the process control system is subject to. Where specifically cited in the process control narratives, the design factors shall reference the associated system design record.

Categories into which the design records should be organized are as follows:

- Process Control and Monitoring
- Electrical and Mechanical
- Safety and Security
- Inventory Management

- Regulatory Reports and Requirements
- Historian.

Within each category, the designer must identify:

- The design record items by English description and symbolic (analytical/mathematical/logical) definition,
- Scientific/engineering and design standards reference source(s) that define or affect the nature of the item,
- The process control system database tags and their descriptions associated with the item as input variables, constants, or results,
- Assumptions, constraints, and constants that directly influence the item.

Section 1.8 - Custom Programming

Some functions unavailable in the present HMI were created using custom visual basic programs. In addition, several administrative tools are used which would be considered custom programming.

Custom programs shall explicitly define each and every variable used within the program. This definition statement (e.g., “Dim” in Basic, etc.) shall define the data type (e.g., integer, real, Boolean, string, etc.) and shall contain a comment indicating how this variable is used. Major blocks of code shall be prefaced with explanatory comments. Comments shall also be included every two to three lines within blocks to detail the working of specific code sequences.

Current custom programs are related to login procedures, routines related to enable control of equipment and various system administration tasks.

An operator is required to log in to the system to gain access to control functions (see Section 1.6 for more information). This login is via the operating system’s standard login dialog boxes and routines. Login routines set drives within the operating system and update local files on the hard disk drive. Routines also change registry entries and perform file management activities to allow an operator to resume viewing the same screen he was viewing prior to logging in.

Equipment control is regulated via custom programs that determine the computer from which control is being attempted and the “role” of the user that has logged in to the system (further information is contained in Section 1.6). Programs performing these functions are embedded within each Standard Screen Template (described in Section 1.2), within equipment standard equipment symbols and within small overlay screens.

A batch command file is used to update screen files on all viewer stations. Timestamps are compared to avoid unnecessary copying. The operating system’s automated replication functions are NOT used so that updates are fully completed and deliberately distributed at an administrator’s discretion.

Section 1.9 - Reporting Point Changes

When a point is changed, it may impact Operation Data Management System (ODMS) reports, up to and including EPA 4500 reports. All requests for point changes shall be sent to ***the District Manager of Process Control and Automation*** for approval **prior to making the change**. The following is a list of reasons to request a point change:

1. A point needs to be added to the point database and archived to the historian.
2. A point needs to be deleted (that was formerly logged to the historian).
3. A point's derivation needs to change (flows, totalizers, etc). This must be done if the change will result in the reported value being offset from previous values.
4. Equipment has been changed or replaced (if deleted, see reason 2), if different scaling is used, new limits or values are required, etc. However, if the new equipment operates the same as the old equipment, existing points may be used and no notification is required.
5. A derived point needs to be added to the point database. This requires notification unless the point is used only for convenience on displays, where it is a calculation based upon otherwise reported points or where the value can be derived in reporting.
6. A general circumstance has arisen that might affect a report.

Items to include in notification:

- The nature of change(s)
- The reason for the request
- The date and time field equipment changed or was placed back in service (if applicable)
- Tag ID(s)
- Cimplicity Database Logging table name(s) (e.g., S_TC_PRESS)
- Oracle field name(s)- usually in the form “[tag_id]_VAL0”; check the appropriate Oracle table if in doubt
- Cimplicity Project for each point (E_PT, E_RS, S_FA, S_LS, S_SA, S_TC, W_WD, W_WW)
- Cimplicity Description(s) / ODMS Label(s)
- Point type (Cimplicity) / Parameter type (ODMS) for each point (flow, service, analytical, etc)
- Range and units (if it is an analog value) for each point

Section – 1.10 - Tag Naming Formats for CLX/WW/PV+

1.10.A – General

This naming convention applies to tags and objects created in Rockwell Logix series of PLC (CLX). Since CLX uses add on instructions (AOI) to pass data between the Wonderware HMI (WW) and the PanelView Plus 6 (or current series) OIT (PV+), the CLX tag name must be identical to the corresponding object name in WW and PV+. Any limitations within those platforms must also be taken into account.

Internal tag naming (tags not communicated to an outside source) is left to the discretion of the programmer. However these tags should be clearly understandable and shall have the first letter of each word capitalized, with no underscores. Example: InternalTagName1.

All tag naming should be consistent. For instance, naming one tag “Input_Pressure1” and another “Input_PSI1” is an example of two names for the same process parameter. Even if these tags are not passed to the HMI, this naming convention is unacceptable.

Point tags are not the same as instrument tags. A point tag refers to the parameter associated with a device; the software tag name. The same loop number shall be used for the instrument tag and point tag.

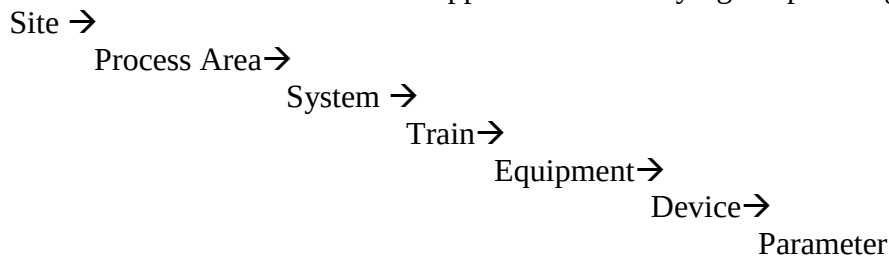
The point tag name must appear in the system integrator provided I/O List.

The NEORS D reserves the right to request a different tag name, should any provided tag names not meet the standard or prove to be unclear.

1.10.B - Format

The approach for tag naming is based upon recognized descriptions for the point tag. All tag names are limited to a total of 32 characters. All acronyms are upper case letters. No spaces are allowed in the tag name; underscores are used instead.

The convention takes a hierarchical approach to identifying the point tag.



Note that not all tags will have every level of the hierarchy.

The CLX/WW Tag format is as follows:

[Site][Area]_[Desc1][Train][Parallel]_[Loop]_[Desc2][Train][Parallel]_[Parameter]

Where,

Site = Site designation, in upper case. Example sites include:

“S” is used for Southerly Wastewater Treatment Center.

“E” is used for Easterly Wastewater Treatment Plant

“W” for Westerly Wastewater Treatment Center

“C” for Collection System Control Facilities

“Q” for Water Quality Surveillance

Area = the two digit process area number. There is no space between the site and process area number designators. Refer to Part II Section 9.1 for a complete and up to date listing of process area numbers.

For systems with remote IO racks, the area number should reflect the location of the IO, not the PLC.

Desc1 = the first descriptor field, intended for the specific process description. If more appropriate, it may be used for primary equipment name, area, building, etc.

Train = the process train number; may appear after the first or second descriptions. Use sequential numbers when more than one train exists.

For examples: INC1 (fluid bed incinerator-train1).

Parallel = the lower case alphabetical designator for multiple equipment operating in parallel on a single process train. This may appear after the first or second descriptions. For example: CNT1a (centrifuge ‘a’ for incinerator train 1).

Loop = the loop number from the flow diagram or instrument tag. This is always a 4-digit number. If the loop number is not available, use “xxxx” as a place holder.

Note that in the case of valves, this will be the valve number and may not match the loop number.

Desc2 = the second description field intended for the equipment or device associated with the tag. It may also be used for sub-process areas or components of a larger piece of equipment.

Additional descriptions (_ [Desc3][Train][Parallel]) may be added to the tag name as needed.

Parameter = the process variable of the associated equipment. When no parameter is needed, this field can be used for the object type, such as PID. This is useful in preventing duplicate tag names.

Not shown in the tag name is the attribute, which is a specific property of an object. The attribute is NOT part of the tag name; it is defined by the object and not modifiable by the user. These attributes will link functionality from the CLX to the WW or PV graphics.

Note: The attribute name (and the “.”) do not count in the 32 character limit.

1.10.C - Object Attributes

To aid in general understanding, a brief explanation of objects and attributes is provided here. For more information please reference the NEORS D Standard Object Library User Manual.

A complete object consists of three parts: an add-on-instruction (AOI) in the ControlLogix family of processors, a global object in the OIT (PanelView), and a template instance in Wonderware. The templates and global objects are designed to align with the AOI, and through base template scripting (HMI) and RSLinxEnterprise (OIT), automatically link the individual graphical properties to AOI parameters.

These graphical properties are referred to as attributes. Some typical attributes include indication, feedback, alarms, and command output.

In the past, each IO point would be mapped to a separate “tag”, resulting in individual tags for different physical IO, such as “Motor running”, “Motor Speed”, or “Motor Start Command”. With the District Standard Objects, separate “tags” are no longer to be used. Instead, all of the parameters of a physical device (limit switches, running feedback, fault indications, etc) are mapped to a single AOI instance in the PLC. The HMI template instance is linked to this AOI via scripting and the use of a common object name. To clarify this principle, consider the implementation of a discrete valve.

Implementation Example

Description: A process water tank1 drain valve 4200 at Southerly Solids Handling Area.

For this example, a discrete control valve will have feedback for open and close, as well as an output for position control.

Using the tag naming format from above, an acceptable root for a tag name becomes:

S57_PWTNK1_4200_DRV

Using objects, the correct way to implement this valve would be to create an instance of the Valve_Discrete object, naming it S57_PWTNK1_4200_DRV, and then map each IO point to the correct parameter of the object AOI:

<u>IO Point</u>	<u>PLC Mapping</u>	<u>HMI Mapping</u>
1:4:I.Ch0	→ S57_PWTNK1_4200_DRV.Inp_OpenLS	→
1:4:I.Ch1	→ S57_PWTNK1_4200_DRV.Inp_CloseLS	→
1:6:O.Ch8	→ S57_PWTNK1_4200_DRV.Out	→
		} S57_PWTNK1_4200_DRV

The HMI scripting places each parameter from the PLC into the associated graphical object attribute.

A common error for programmers new to the idea of objects is to implement the valve using smaller individual objects, such as a Discrete and Discrete_Indicator. This technique is shown below as a method of how NOT to implement objects:

Create Discrete_Indicator object S57_PWTNK1_4200_DRV_Opened.

<u>IO Point</u>	<u>PLC Mapping</u>	<u>HMI Mapping</u>
1:4:I.Ch0	→ S57_PWTNK1_4200_DRV_Opened.ind	→ S57_PWTNK1_4200_DRV_Opened.ind

Create Discrete_Indicator object S57_PWTNK1_4200_DRV_Closed.

<u>IO Point</u>	<u>PLC Mapping</u>	<u>HMI Mapping</u>
1:4:I.Ch1	→ S57_PWTNK1_4200_DRV_Closed.ind	→ S57_PWTNK1_4200_DRV_Closed.ind

Create Discrete object S57_PWTNK1_4200_DRV_CMD.

IO Point PLC Mapping HMI Mapping
1:6:O.Ch8 → S57_PWTNK1_4200_DRV_CMD.state → S57_PWTNK1_4200_DRV_CMD.state

1.10.D - Process, Equipment & Parameter Names

Within the tag name format, most fields are intuitive: site, process area, train, and loop should all be clearly defined. This “fixed” portion of the tag name consumes 11 to 13 characters. The process and equipment names are equally known, but need to fit within the remaining 19 characters. To aid the programmer in tag name development, the District has compiled a list of frequently encountered process terms along with the acceptable abbreviation.

For other process and equipment names not listed, it is the programmer’s responsibility to choose a name that is easily recognized and meets the number of character limitation. Each created process or equipment name must be consistent through all programming, including HMI, OIT and multiple PLC programs. For example: if the equipment name for windbox is set as “windbox” in a PLC tag for incinerator 1, then the PLC for incinerator 2 must also refer to it as “windbox”; “wind_box would not be acceptable.

The complete list of abbreviations is given in Part IV Section 7 – Process, Equipment, & Parameter Abbreviations. New abbreviations should be reviewed by the District or its representative prior to implementing in a tag name.

1.10.E - Example Tag Names

The following examples are provided to assist in illustrating the tag naming format.

S47_INC1_xxxx_WB_PSI

where “S” represents the Southerly site.
“47” is the process area number for incineration.
“INC1” is the fluidized bed incinerator, process train 1.
“WB” is windbox, the device or equipment description.
“PSI” is pressure, the process parameter.

CNM_BS1_Inlet_LVL

where “C” represents a collection site (Remote Pump Station in this case).
“NM” is for “Nine Mile”.
“BS1” is for bar screen 1.
“Inlet_LVL” is level on the inlet side.

Since a Remote Pump Station and similar sites do not need numerical “process area numbers”, the two character alpha abbreviation (nm, for example) will serve as the location in the ProcessAreaNumber/Location part of the tag.

Other sample ControlLogix and Wonderware tags:

S47_INC1_xxxx_PHB1_NG_FLW (pre-heat burner 1 natural gas flow)

S57_CNT1A_xxxx_ScrollDrive_SPD (centrifuge ‘a’ on train 1, scroll drive speed)

S57_POL_xxxx_STNK1_LVL (polymer storage tank 1 level)

S57_PHU1A_xxxx_PLP_PipeA_PSI (pump hydraulic unit, train 1, unit “a”, pipeline lubrication pump pipe “a”, pressure)

S57_SH_xxxx_SK_TMP1_HH (solids handling, skimmings temperature 1, HIHI)

S57_SH_xxxx_SK_TMP1_HH_STPT (solids handling, skimmings temperature 1, HIHI alarm setpoint)

When an average is created from several redundant measurements, use the following example as a guide:

S47_INC_3100A_HX_IN_GAS_TMP (heat exchanger inlet gas temperature A)

S47_INC_3100B_HX_IN_GAS_TMP (heat exchanger inlet gas temperature B)

S47_INC_3100C_HX_IN_GAS_TMP (heat exchanger inlet gas temperature C)

S47_INC_3100AVG_HX_IN_GAS_TMP (heat exchanger inlet gas temperature average)

1.10.F - Format for Description Field

The point tag description, in CLX, WW, and PV+, shall consist of the P&ID tag name (in upper case letters), followed by a full description of the tag.

1.10.G - Other Requirements

All IO list must include the point tag and corresponding object_name.attribute information, as well as any alarm descriptions. Alarm descriptions must be consistent between HMI and OIT.

SECTION – 2 - PLC PANEL CONSTRUCTION STANDARDS

Section 2.0 - Introduction

This section reviews the conventions for PLC panel construction.

Section 2.1 - Panel Construction

Article I provides the detailed requirements for the construction of control and PLC panels. Included in this article are the requirements for the following:

- A. Documentation
- B. General Panel Requirements
- C. Panel Construction Requirements
- D. Environmental Control
- E. Electrical Requirements
- F. Identification
- G. Warranty
- H. Inspection and Testing
- I. Factory Acceptance Test
- J. Site Acceptance Test

Article II provides reference standards and Article III contains installation details. CONTRACTOR shall provide all labor, materials, equipment, and incidentals required to furnish, install, calibrate, test, start-up, and place into satisfactory operation all control panels and/or enclosures. No omission in these or related specifications and/or drawings shall relieve the CONTRACTOR of supplying complete, functional, and operational panels or equipment.

Related References: NEORS D Electrical Standards and Conventions Manual

Detailed Specifications

A. Documentation

1. Layout drawings, wiring schematics, and parts lists are to be supplied in hard and electronic copy for approval before building commences. On successful completion of site acceptance test, the CONTRACTOR shall provide all “As-Built” documentation and drawings in hard and electronic copy. All final and field mark-ups shall be incorporated electronically. Hand-written revisions are not acceptable. Final documentation must include the following:
 - a. Wiring diagrams including all wire and terminal numbers
 - b. Wiring schedules and interconnection diagrams
 - c. Panel layouts
 - d. Parts list or bill of materials showing tag number or identifier, quantity, make, model number, and description for panel and all components and devices.
 - e. Installation drawings

- f. Installation, operation & maintenance manuals
 - g. All information, including panel weight, power supply requirements, etc. necessary for installation of the control panel(s)
 - h. Test and completion certificates
 - i. Operating characteristics of fuses and circuit breakers (manufacturer's technical data sheets)
 - j. Size and weight of all shipping containers.
2. Provide a list of recommended spare parts.

B. General Panel Requirements:

- 1. Provide all electrical components and devices, support hardware, fasteners, and interconnecting wiring to make the control panels complete and operational.
- 2. Locate and install all devices and components so that connections can be easily made and so that there is ample room for servicing or replacing each item.
- 3. Unless otherwise specified, cable and conduit entry will be from the top of panels.
- 4. Adequately support and restrain all devices and components mounted on or within the panel to prevent any movement.
- 5. Provide sub-panels for installation of all relays and other internally mounted components.
- 6. The panel shall be sized for 25 percent additional space requirements beyond present needs for future use. Both the front of the panel where devices are mounted and the interior of the panel shall be sized for 25 percent spare space. Nothing shall be mounted in space reserved for future use.
- 7. All I/O spares shall be fully pre-wired from the I/O terminations to the panel side of interposing terminals. (The other side of the interposing terminals is reserved for field terminations).
- 8. Panel shall be equipped with door(s) for front of panel opening.
- 9. All vendor-supplied or sub-contractor supplied panels shall also conform to the requirements of this and related specifications.
- 10. CONTRACTOR shall be responsible for the detailed layout and design of the panels in accordance with standard practice and techniques and local and national codes and requirements. The actual layout shall be subject to approval by ENGINEER.
- 11. Panel shall be UL approved and meet applicable UL standards including, but not limited to, UL 508 [Standard for Industrial Control Equipment] , UL508A [Standard for Industrial Control Panels], UL 698 [Standard for Industrial Control Equipment for Hazardous (Classified) Locations], UL 698A (Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations].
- 12. Panel shall meet applicable sections of the latest edition of the NEC including, but not limited to, Article 409 [Industrial Control Panels]. Provide calculation and/or method for determining short-circuit current rating.
- 13. All panels, materials and equipment shall be new and shall be built in an Underwriters Laboratory (UL) approved panel shop and bear the UL label.

C. Panel Construction Requirements

1. Panels located in control rooms and other environmentally-controlled rooms shall be steel with a NEMA 12 rating.
 - a. Exterior surfaces to be primed and painted with three coats enamel or better. Color to be ANSI 61, light gray or as specified.
 - b. Interior and mounting panels to be primed and painted with two coats of white enamel or better.
 - c. Provide one quart of touch-up paint for each color
 - d. Mounting panels to be 12 gauge steel.
2. Panels located in all other locations shall be Type 316L unpainted stainless steel with a smooth brushed finish and a NEMA 4X rating.
 - a. Mounting panels to be stainless steel.
 - b. Seamless foam-in-place door gasket.
 - c. All panel penetrations shall be sealed watertight and maintain the NEMA 4X panel rating.
 - d. Any panel or door mounted devices (e.g., pushbutton) or instruments shall have a NEMA 4X rating. Whenever an instrument is not available with a NEMA 4X rating it shall be mounted with a clear plastic, gasketed, lockable hinged door.
3. Floor-mount panels shall be minimum 12-gauge for all surfaces.
 - a. Seams continuously welded and ground smooth
 - b. Remove corrosion, burrs, sharp edges, and mill scale
 - c. No holes or knockouts unless otherwise specified
 - d. Removable heavy gauge continuous stainless steel door hinges.
 - e. Provide 12-inch floor stands welded to the enclosure unless otherwise specified. Floor stands to be stainless steel for NEMA 4X panels.
 - f. Rolled flanges around three sides of door and all sides of enclosure opening to exclude liquids and contaminants
 - g. Overlapping doors or removable center post.
 - h. Body stiffeners and panel supports as required
 - i. Provide handle-operated, oil-tight, key-lockable three point stainless steel latching system with rollers on latch rods for easy door closing for control room panels.
 - j. Data pocket mounted inside panel on door(s)
 - k. Oil-resistant door gasket with oil-resistant adhesive
 - l. Ground studs in body of enclosure
 - m. Bonding provision on doors
 - n. Lifting eyes, as required. NEMA 4X panels to have stainless steel lifting eyes.
 - o. Bottom 12 inches of panels shall be free of all devices, including terminal strips, to provide ease of installation and testing
 - p. No device mounted on a surface or door of the panel shall be mounted less than 36 inches above the operating floor level unless otherwise specified.
4. Frame or wall-mounted panels shall be minimum 14-gauge for all surfaces.
 - a. Seams continuously welded and ground smooth
 - b. No holes or knockouts unless otherwise specified

- c. Removable heavy gauge continuous stainless steel door hinges.
 - d. External wall-mounting brackets
 - e. Rolled flanges around three sides of door and all sides of enclosure opening to exclude liquids and contaminants
 - f. Stainless steel quick release screws and clamps on three sides of each door
 - g. Hasp and staple for padlocking
 - h. Data pocket mounted inside panel on door(s)
 - i. Oil-resistant door gasket with oil-resistant adhesive
 - j. Ground studs in body of enclosure
 - k. Bonding provision on doors
5. Panels Located in Hazardous (Classified) Locations
- a. In addition to meeting the applicable requirements of this specification:
 - 1) Indoor panels to be installed in NEC Class 1, Division 1 or 2 areas (gas/vapor locations) shall meet NEMA 7 requirements.
 - 2) Indoor panels to be installed in NEC Class 2, Division 1 or 2 areas (dust locations) shall meet NEMA 9 requirements.
 - b. Required Features:
 - 1) Light weight and corrosion resistant copper-free aluminum
 - 2) Integral, cast-on mounting lugs
 - 3) Viewing windows, if required, sized to suit internally-mounted components
 - 4) Stainless steel cover bolts
 - 5) Cadmium-plated steel mounting pans
 - 6) Manufacturer: Adalet or equal
 - c. CONTRACTOR may meet hazardous area requirements through alternate means such as purging or the use of intrinsic safety barriers only after consultation with ENGINEER and with ENGINEER's expressed, written consent.

D. Environmental Control

- 1. Provide 120 VAC strip heaters inside panels, as required, to maintain panel temperature 10°F above ambient to prevent condensation within panel.
- 2. Provide automatically-controlled closed-loop ventilation fans or closed-loop air conditioners with filtered air louvers, if required, to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside.
- 3. Air conditioner shall have a minimum capacity of 4,000 BTU.
- 4. Provide thermostatic control for automatic changeover from heating to cooling without the need for manual intervention.
- 5. Alternative cooling methods such as vortex coolers, thermoelectric heater/coolers or heat exchangers are acceptable but need approval of ENGINEER. Contractor shall supply District-approved air compressors if vortex coolers are approved by the District.
- 6. Provide heat calculations for each panel or enclosure to verify that there is sufficient dissipation of generated heat to maintain interior panel temperature

and humidity within the maximum and minimum operating parameters of all panel components.

E. Electrical Requirements

1. Power Source and Internal Power Distribution

- a. Panel power supply voltage, breaker size (in amps), power panel identification, and circuit number shall be shown on the Drawings.
- b. The panels shall be provided with an internal 120 VAC power distribution with separate circuit breakers, sized as required, to distribute power. Provide circuit breakers for 24 VDC instruments with no more than six devices on a single circuit. Provide 20% spare (minimum of two) installed breakers or fused terminations for each type and voltage level.
- c. All 120 VAC instrument power circuits shall be protected by separate DIN rail mounted circuit breakers by Idec or equal.
- d. When DC power and/or low voltage AC power is required, provide, install, and wire the necessary power supplies and transformers in the panel. For example, all panels shall have a 24 VDC power supply wired to power analog signals that are not otherwise powered.

2. Convenience Accessories

- a. One 120 VAC, 20 A, duplex, grounding type receptacle.
- b. 120 VAC fluorescent light fixture(s) with shielding and filtering to minimize EMI. Lamp wattage (minimum 20 W) and number of fixtures suitable for sufficient illumination of entire panel.
- c. One 120 VAC, 20A snap switch for light fixture(s), mounted in a metal outlet box with a metal cover. Locate in an area easily accessible from access door.
- d. The light fixture(s) and duplex receptacle shall have its own circuit breaker wired to separate terminals for separate 120 VAC service.

3. Wiring and Termination

- a. All wiring to panel connections from field instruments, devices, and other panels shall be terminated at master- numbered terminal strips, unless otherwise specified.
- b. Splicing of conductors or cables is not permitted.
- c. Provide copper grounding studs for all panel equipment.
- d. Internal wiring shall be Type THHN stranded copper wire with thermoplastic insulation rated for 600 V at 85 C for single conductors, color coded and labeled with wire identification.
- e. For internal panel DC signal wiring, use shielded, minimum No. 18 AWG. For DC field signal wiring, terminal strips shall be capable of handling minimum No. 12 AWG wiring.
- f. For internal panel AC power wiring, use minimum No. 12 AWG. For AC signal and control wiring, use minimum No. 16 AWG. For wiring carrying more than 15 amps, use sizes required by the NEC.
- g. Separate and shield DC signal wiring from power and control wiring by a minimum of 6 inches. Design to avoid DC and power/control wiring from

- crossing each other. If a crossing cannot be avoided, then the crossing shall be at right angles.
- h. Group or bundle parallel runs of wire using covered, slotted troughs. Maximum bundle size to be 1 inch. Troughs shall have 50 percent spare design capacity.
 - i. Install wire troughs along horizontal or vertical routes to present a neat appearance. Angled runs are not acceptable.
 - j. Mount wire troughs parallel to terminal strips. Provide adequate spacing, with a 4" minimum, in order to read wire identification tag without opening wire trough or moving any wires or panel components.
 - k. Adequately support and restrain all wiring runs to prevent sagging or other movement.
 - l. Terminate all field wiring on minimum 600 V rated terminal blocks. Fused terminal blocks shall have a minimum 300 V rating and shall have blown fuse indication. All terminal blocks shall be mounted on rigid, high rise aluminum DIN rail. Use Allen-Bradley Cat. No. 1492-DR6 or approved equal. Terminal blocks shall be IP2X finger safe and UL rated. No 120 VAC (or higher voltage) exposed terminals allowed. Terminal blocks shall accommodate minimum 12 AWG wire. Terminals to have screwed connections and numeric identifiers beside each connection. Identifiers to be plastic inserts or self-stick plastic tape with permanent, machine-printed numbers. Provide Allen-Bradley 1492 series, Phoenix Contact or approved equal.
 - m. All wiring shall be installed such that if wires are removed from any one device, power will not be disrupted to any other device.
 - n. All spare I/O points shall be wired completely to all termination points including PLC I/O terminations and interposing terminal blocks.
 - o. Provide spare terminal blocks equal in number to 20 percent of the terminals used for each type of wiring (i.e., DC signal, AC power, shields, and grounds) and for each type of terminal block with a minimum quantity of five for each type of block and type of wiring. Provide a separate terminal for grounding each shielded cable.
 - p. Use separate 5/16-inch diameter copper grounding studs for instrument signal cable shields and AC power.
 - q. Where wires pass through panel walls, provide suitable bushings to prevent cutting or abrading of insulation. Penetrations to be sealed according to panel NEMA rating and environmental requirements.
 - r. Provide complete wiring diagram showing "as built" circuitry. All revisions must be done in CAD—no hand-written revisions allowed. Diagram shall be enclosed in transparent plastic and placed in easily accessible pocket built into panel door.
 - s. Comply with applicable requirements of Section 2.3 – Panel Wiring and Part II, Section 7 – Electrical Standards
4. EMI / RFI Protection
- a. Construction and design techniques shall be used to minimize EMI / RFI. Use shielding, physical separation, filters, ferrite beads, or other methods

to insure no interference to or from electrical or battery-operated components or devices.

5. Surge Protection

- a. General: Surge protection shall be provided to protect the electronic instrumentation system from surges propagating along the signal and power supply lines. The protection systems shall be such that the protection level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and be maintenance free and self-restoring. Instruments shall be housed in suitable metallic cases, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and where practical each ground wire run individually and insulated from each other. These protectors shall be mounted within the instrument enclosure or a separate junction box (compatible with the area designation) coupled to the enclosure.
- b. Provide formal lightning and surge protection devices for all signal lines, data highways, and power interfaces with PLCs at remote sites. For signal lines, data highways, and power feeds to control panels and PLC hardware, provide formal lightning and surge protection devices for all lines that originate or are routed outside a building on any part of the existing or proposed circuit, either in buried or exposed raceways.
- c. Lightning and surge protection devices shall be standard manufactured products comprising multi-component networks or hybrid circuits. The units shall incorporate gas filled discharge tubes, metal oxide varistors, and/or zener diodes providing full protection from line to line and from line to ground. Units shall be DIN-rail mounted, rated for a minimum 10kA maximum surge current and voltage suitable for the type of circuit being protected. Reaction time shall be on the order of nanoseconds.
- d. For signal lines use the SD series, as manufactured by MTL, or approved equal.
- e. For data highways use MTL ZoneBarrier or IP series data communications protectors; or the Suppressor, as manufactured by ITD, or approved equal.
- f. For fieldbuses use FP or TP series from MTL, or approved equal.
- g. For AC power lines use MA series from MTL, or approved equal.

F. Identification

1. Provide laminated plastic nameplates for identification of panels and its components. Nameplates shall be 3/32-inch thick laminated phenolic type with white matte finish and black letter engraving. Nameplates shall be attached to the panel face with two stainless steel self-tapping screws.
 - a. Panel identification nameplates to have 1/2-inch high letter engravings.
 - b. Panel-mounted component (i.e., control devices, indicating lights, selector switches, instruments, etc.) identification nameplates to have ¼-inch high letter engravings. Include legend plates for items like push buttons, pilot lights and selector switches to show indication or position function (e.g., ON or HAND-OFF-AUTO).

- c. Nameplate engravings shall include the instrument or equipment tag number and descriptive title as shown and specified.
2. Tag all internally-mounted instruments in accordance with the following requirements:
 - a. Tag numbers shall be as listed in the Instrument Index, data sheets, drawings, or specifications.
 - b. The identifying tag number shall be permanently etched or embossed onto a stainless steel tag securely fastened to the device housing with stainless steel rivets or self-tapping screws of appropriate size.
 - c. Where neither of the above fastenings can be accomplished, tags shall be permanently attached to the device by a circllet of 1/16-inch diameter stainless steel wire rope.
 - d. Identification tags shall be installed so that numbers are easily visible to service personnel.
 - e. Front of panel mounted instruments shall have the tag attached to rear of device (in addition to the front of panel nameplate).
3. Label internally mounted components and devices (e.g., power supplies, power distribution blocks), mounting rails (e.g., for terminal blocks), etc. with phenolic nameplates attached with self-tapping stainless steel screws or adhesive or with other approved method. Attach to mounting plate or panel surface near the device in a manner that makes identification unambiguous. Manufacturer-provided identification means are acceptable if approved by the ENGINEER.
4. Tagging of the following items shall be accomplished with the use of machine-generated adhesive plastic labels by Brady or equal.
 - a. Tag all electrical devices (circuit breakers, relays, timers, etc) mounted within control panels and enclosures. Do not cover model numbers or other text or indicating lights.
 - b. Numerically tag individual terminals or terminal blocks (pre-printed push-on plastic labels from vendor may be used).
 - c. Color code and numerically tag wiring at each end according to drawings or other documents, as applicable.
 - d. Tag all pneumatic lines.

G. Warranty

1. The CONTRACTOR is responsible at their expense for the replacement of any defective component(s) or the repair of failed systems which arise for a minimum of twelve months after shipment to the OWNER. Repaired or replaced components shall be warranted for a period of not less than six months from date of shipment to the OWNER or the remainder of the original warranty term, whichever is longer.

H. Inspection and Testing

1. All panels, consoles, and cabinets shall be inspected by the CONTRACTOR. Inspection shall include, but not be limited to, the following:

- a. Nameplates, warning labels, and tags including correct spelling, color and size of labeling and characters
 - b. Enclosure flatness, finish, and color
 - c. Proper operation of doors, catches, and locks
 - d. Wire types, sizes, and colors
 - e. Proper wiring layout, practices and grounding
 - f. All electrical circuits checked for continuity
 - g. Terminal block contact ratings and numbers
 - h. Terminal block, fuse, breaker, & other required installed spares
 - i. General arrangement and space allocation
 - j. AC/DC power checks
 - k. Power fail/restart tests
 - l. Diagnostic checks
 - m. All electrical circuits energized simultaneously and continuously for 48 hours without failures
 - n. All alarm circuits connected to simulated alarm contacts to verify operation
 - o. All interlock and shutdown circuits checked for operability and proper function by means of simulated contact
 - p. All input/output devices and components shall be tested to verify operability and basic calibration.
 - q. Simulate operation of electronic control and receiving instruments and circuits
 - r. Test demonstrating that all specified equipment functional capabilities are working properly.
 - s. Verify that communication between units is working properly
 - t. Any other test required to place the panel in an operating state
 - u. Compliance with specifications, standards, and codes
2. The ENGINEER reserves the right to inspect the work-in-progress at any time during the construction or testing of the panels. CONTRACTOR shall notify ENGINEER when:
 - a. Panels are furnished with components and wiring is 25% complete.
 - b. Panels are complete and CONTRACTOR tested.
 3. The ENGINEER shall have the right to request any additional tests that are deemed necessary to prove the operation of the panel(s) or adherence to the specification, standards, or codes.
 4. Witnessing by the ENGINEER of any tests and inspections at the CONTRACTOR's premises (or elsewhere) shall not imply acceptance of responsibility for any faults or failings subsequently found.
 5. All problems or discrepancies must be corrected and required retesting completed before final approval for shipment is given by the ENGINEER.

I. Factory Acceptance Test

1. In the case of panels which form part of an overall control or operating system or at the ENGINEER's discretion, testing at the CONTRACTOR's facility will be required.

2. The CONTRACTOR shall be required to write test plans, if required, and perform the testing. If required, CONTRACTOR shall also perform and document testing prescribed by ENGINEER and to document testing on ENGINEER-provided forms. Testing to be witnessed by the ENGINEER.
3. Copies of all test plans and results, certificates, etc. shall be provided to the ENGINEER.
4. It shall be the responsibility of the CONTRACTOR to furnish all necessary testing devices which must have a current, valid certificate of calibration. Calibration records must be produced to the ENGINEER on request.

J. Site Acceptance Test

1. If part of the contract requirements, the CONTRACTOR shall be required to be on-site with the appropriate hardware and personnel for unpacking and installation of the control panels.
2. Comply with contract requirements for testing and/or Section 01660, Field Tests of Equipment.

Reference Standards

- American Society for Testing and Materials (ASTM).
- National Fire Protection Association (NFPA) and the National Electrical Code (NEC).
- National Electrical Manufacturers Association (NEMA) Standards.
- National Institute of Standards and Technology (NIST)
- American National Standards Institute (ANSI).
- Underwriters Laboratories, Inc (UL)
- Factory Mutual (FM)
- The International Society of Automation (ISA)
- Occupational Safety and Health Administration (OSHA) Regulations.
- Federal, state, and local code requirements.
- Where any conflict arises between codes or standards, the more stringent requirement shall apply.

Installation Details - this section does not contain all installation details for the equipment/system shown, only those that are required by the NEORSD. These details may exceed those required by the equipment manufacturer or local codes.

1. Install equipment in conformance with NEC.
2. Unless otherwise noted, install indoor, freestanding and floor-mounted panels on 4-inch grout pad. Lay grout after panel sills have been securely fastened down. Extend pad 4 inches beyond outside dimensions of base, all sides, solid, face-to-face.
3. Unless otherwise noted, install outdoor free-standing and floor-mounted panels on a reinforced concrete pedestal:
4. Minimum Thickness: 8 inches with No. 4 steel reinforcing bars at 12 inches on centers, each way.
5. Minimum Size: 12 inches larger than outer dimensions of base, each side.
6. Provide excavation and backfill work in conformance with the Division 2 specifications.
7. Provide concrete work in conformance with the Division 3 specifications.

8. Unless otherwise noted, install all frame-mounted indoor and outdoor panels using 316 stainless steel strut style structural support framing system members, plates, and fasteners. Frame bases shall be installed on a minimum one-inch thick non-shrink grout pad with edges sloped away from the base plate.
9. Install wall mounted enclosures and control panels using appropriately sized aluminum or 316 stainless steel strut style support channels securely anchored to wall surface to provide offset mounting for air circulation behind panel. Do not install wall-mounted panels directly on wall surfaces. Comply with requirements of the Division 26 specifications for support framing system materials and methods. (Reference Part II, Section 7.1)
10. Install anchor bolts and anchor in accordance with the Division 5 specifications.
11. Install and interconnect all equipment, devices, electrical hardware, instrumentation, controls, and process control components into and out of and among the enclosures.

Section 2.2 – PLC Hardware & Software

2.2.A – Allen Bradley PLC-5 (no longer specified for new construction)

2.2.B – Rockwell SLC-500 Series (no longer specified for new construction)

2.2.C - Rockwell ControlLogix

Detailed Specifications

A. PLC Processors:

1. Program Memory Size: 4M Bytes minimum.
2. Memory Type: Program and data in non-volatile RAM, backed up with an energy storage module. Operating system in non-volatile firmware.
3. I/O Capacity: 128,000 discrete I/O (any mix of inputs and outputs) or 4000 analog I/O, maximum.
4. Up to 500 connections (nodes). Up to 64 connections over ControlNet (maximum of 48 recommended). Up to 128 connections over Ethernet / IP.
5. Bit execution time less than 0.15 microseconds.
6. Installation Location: Left-most slot of the I/O chassis (typical).
7. Diagnostics:
 - a. Standard, self-diagnostic routines shall be provided to determine proper hardware and software operation.
 - b. Diagnostic LEDs shall be provided on the processor front panel to indicate the following:
 - 1) Processor running.
 - 2) Processor fault.
 - 3) Battery low.
 - 4) Forced I/O.
 - 5) Communications active.
 - 6) Communications error.
8. Communications: The PLC processor shall be equipped with on-board communications ports for the following:
 - a. USB port.

9. **Instruction Set:**

- a. The PLC shall be equipped with the following instructions as a minimum:
 - 1) Relay-type logic functions including normally open contacts, normally closed contacts, and output coils.
 - 2) Timers: On delay, off delay, and retentive.
 - 3) Counters: Up, down.
 - 4) Math functions including integer and floating point, add, subtract, multiply, divide, and square root.
 - 5) Data transfer instructions.
 - 6) Logical AND, NOT, OR, XOR instructions.
 - 7) Compare Instructions: Equal to, greater than, less than.
 - 8) Proportional - Integral - Derivative control instruction.
 - b. The PLC shall support branching functions to allow any combination of series or parallel instructions.
 - c. The PLC shall support the use of subroutines where appropriate.
10. Programming software: Rockwell RSLogix 5000. IEC 61131-6 compliant.
Available languages:
- a. Ladder logic
 - b. Function block diagram (FBD)
 - c. Sequential function charts (SFC)
 - d. Structured text
11. Online programming including run-time editing
12. Manufacturer and Model:
- a. Allen-Bradley Cat # 1756-L7X-K, where X is the numeral 2 or higher current model.
 - b. Order with conformal coating ("K" designation) when available.

B. **Network Communications:**

In addition to the communication ports available on the processor, select communication modules for the following networks, as required:

1. Ethernets / IP (Cat# 1756-ENBT or 1756-EWEB [for web-enabled Ethernet] or 1756-EN2T [for redundant rack communication])
2. ControlNet (Cat# 1756-CNBK)
3. DeviceNet (Cat# 1756-DNBK)
4. Data Highway Plus (DH+) (Cat# 1756-DHRIOK)
5. Universal Remote I/O. (Cat# 1756-DHRIOK)
6. Foundation Fieldbus (Cat# 1788-CN2FF or Cat# 1757-FFLDK)
7. HART (latest version of ProSoft HART Multi-drop Master Communications Module, Cat# MVI56-HART, etc.)
8. Modbus (latest version of ProSoft Modbus Master/Slave Enhanced Communications Module, Cat# MVI56E-MCM)
9. Serial Network (Built-in serial port on processor or Cat# 1756-MVI, -MVID)
10. DH-485 (Built-in serial port on processor)
11. Order with conformal coating ("K" designation) when available.

C. **Power Supplies:**

1. Chassis Power: Each PLC processor and remote I/O chassis shall include a power supply. The power supply shall be sized, at a minimum, to accommodate all spare and future I/O. The power supply shall be mounted on the left end of the I/O chassis and plug directly into the backplane. If the addition of I/O to an existing chassis requires a larger power supply, then that power supply shall be supplied by the contractor or responsible entity.
2. Input Voltage: 120 VAC, 60 Hz.
3. Output Current: 13 A at 5 VDC, minimum.
4. Provide all cabling as required.
5. Manufacturer and Model:
 - a. Allen-Bradley 1756-PA75/BK
 - b. Order with conformal coating ("K" designation) when available.
6. Field Devices: Provide power supply to power field devices that require 24 VDC. Mount alongside I/O chassis.
7. Input Voltage: 120 VAC, 60 Hz
8. Output Current: Sized for loads at 24 VDC, with 25% spare capacity.
9. Provide all cabling as required.
10. Manufacturer and Model:
 - a. Allen-Bradley 1606-XLS Performance Series
11. Provide DeviceNet or other fieldbus power supplies and power conditioners, as required.

D. I/O Chassis:

1. Type: I/O chassis designed to house the PLC processor, network communication interface modules (including Ethernet, ControlNet, DeviceNet, and universal remote I/O communication modules, etc.), and the I/O modules. The chassis shall be sub-panel mounted.
2. Provide all required signal and power cables between I/O chassis and power supplies, as required.
3. Manufacturer and Model:
 - a. Allen-Bradley 1756-A4K (4 slot), 1756-A7K (7 slot), 1756-A10K (10 slot), or 1756-A13K (13 slot), 1756-A17K (17 slot). All are back-panel mount type.
 - b. Order with conformal coating ("K" designation) when available.
4. Available with Class 1, Division 2 hazardous area certification.

E. I/O Modules:

1. Available Types: The types of I/O modules available for use with the PLC system shall be as required. Provide screw-clamp or spring-clamp extended depth removable terminal blocks for all I/O cards (depending on configuration of interposing terminations). Wire size range from #22 AWG to #12 AWG. The following types of manufacturer standard I/O modules shall be available:
 - a. Sixteen point individually isolated discrete input modules which accept an input of 120 VAC, 60 Hz. (Cat# 1756-IA16IK)
 - b. Sixteen point individually isolated discrete input modules which accept an input of 24 VDC, sink or source. (Cat# 1756-IB16IK)

- c. Sixteen point isolated output modules. Each output point shall be independently fused and individual blown-fuse indication for each point. Isolated outputs shall have a current capacity of 2 amps at 120 VAC. (Cat# 1756-OW16IK)
 - d. Sixteen point isolated discrete output modules @ 24 VDC, sink or source with each output fused with individual blown-fuse indication. (Cat# 1756-OB16IK)
 - e. Eight point isolated relay output modules with an output current capability of 2A at 120 VAC per point. (Cat# 1756-OX8IK)
 - f. Eight point isolated analog input modules (16 bit minimum resolution) which accept an input of 4-20 mA DC and read the HART signal. (Cat# 1756-IF8HK)
 - g. Six isolated thermocouple inputs. (Cat# 1756-IT6IK) (However, use transmitters and 4-20mA inputs whenever possible.)
 - h. Six isolated RTD inputs. (Cat# 1756-IR6IK) (However, use transmitters and 4-20mA inputs whenever possible.)
 - i. Eight point isolated analog output modules (15 bit minimum resolution) which produce an output of 4-20 mA DC and read the HART signal. Analog output modules shall allow selectable output response to faults of minimum, maximum, or last output value. (Cat# 1756-OF8HK)
 - j. Slot fillers for unused I/O slots. (Cat# 1756-N2)
 - k. Order with conformal coating ("K" designation) when available.
2. Required Features: The I/O modules and system hardware supplied shall incorporate the following design and construction features and comply with the following requirements:
- a. All I/O modules shall be supplied with Allen-Bradley extended depth removable terminal blocks that plug into the front of the I/O module.
 - b. Noise immunity and filtering.
 - c. IEEE surge-withstand rating to IEEE 472.
 - d. Optical isolation for all inputs and outputs to provide controller logic protection.
 - e. Any card, any slot, plug-in packaging. Mechanical keying of I/O module to its removable terminal block (RTB) to ensure module is placed in correct slot after removal. Electronic keying between I/O module and processor ensures correct module type and revision. All modules shall be replaceable under power.
 - f. Software configuration of modules (no jumpers or switches).
 - g. 300 volt I/O wiring terminal arms sized to accommodate up to #14 AWG wires. Wiring design shall allow I/O module removal and replacement without disturbing I/O wiring connections.
 - h. Front-of-module LED Status indicators for each individual input and output point are to indicate when power is applied at I/O terminals.
 - i. Fused output circuits for all output modules with blown fuse indication.
 - j. Where required and recommended by the manufacturer, external transient suppressor shall be provided for installation across the output loads.

- k. Scaling to engineering units for analog modules.
 - l. Provide required connectors with each I/O module.
 - 3. Provide minimum 20% spare installed I/O for each type of I/O installed in every chassis.
 - 4. Provide minimum 25% spare space in every chassis for future expansion.
 - 5. All I/O, including spares, shall be wired to terminal blocks prior to interconnection with other devices. See Part II, Section 5.1 – Panel Construction; Paragraph E.3, for terminal requirements.
 - 6. Manufacturer:
 - a. Allen-Bradley - Model according to I/O Schedule.

F. Software:

- 1. Provide a licensed copy of all programming and configuration software to the District, including electronic and hard copies of all manuals. The following software packages shall be furnished in addition to all other software necessary for the proper programming and configuration of the PLCs and their components:
 - a. RS Logix 5000
 - b. RS NetWorx for ControlNet
 - c. RS NetWorx for DeviceNet
 - d. RS Linx
 - e. FactoryTalk View ME

Section 2.2.D - Rockwell CompactLogix

Detailed Specifications

A. PLC Processors:

- 1. The processor shall have a memory expansion submodule with a minimum of 2 megabytes of user memory.
- 2. I/O Capacity: Total I/O maximum of 480 (any mix).
- 3. Module Expansion: Minimum of 2 banks.
- 4. Program Scan Time: 0.08 ms (Boolean).
- 5. Installation: Left most module on PLC DIN rail.
- 6. Communication Ports: One (1) USB port and two (2) Ethernet ports.
- 7. Manufacturer and Model: Allen-Bradley CompactLogix 1769-L33ER-K, or current model.
 - a. Order with conformal coating (“K” designation) when available.
- 8. Programming Software: Rockwell RSLogix 5000. IEC 61131-6 compliant.

B. Network Communications:

- 1. Ethernet I/P – use port on processor. If additional Ethernet ports are required then use model 1768-ENBTK.
- 2. ControlNet: Cat# 1769-CNBK
- 3. DeviceNet: Cat# 1769-SDNK
- 4. Other networks, as required.
- 5. Order with conformal coating (“K” designation) when available.

C. Power Supplies:

1. Input Voltage: 120 VAC, 60 Hz
2. Output Current: 4A at 5 VDC, minimum
3. Provide cabling, as required.
4. Manufacturer and Model: Allen-Bradley Cat# 1769-PA4K.
 - a. Order with conformal coating when available
5. Field Devices: Provide power supplies to power field devices that require 24 VDC. Mount next to modules.
 - a. Input Voltage: 120 VAC, 60 Hz
 - b. Output Current: Sized for loads at 24 VDC with 25% spare capacity.
 - c. Provide cables and fusing
 - d. Manufacturer and Model:
 - 1) Allen-Bradley 1606-XLS Performance Series
6. Power DeviceNet or other fieldbus power supplies and power conditioners, as required.

D. I/O Modules:

1. Analog Input:
 - a. Inputs: 4 differential or single-ended 4-20 mA (isolated) with HART communications
 - b. Resolution: 16-bit (unipolar)
 - c. Installation: PLC DIN rail. Provide all DIN rail and mounting hardware.
 - d. Connection Adapter, Cable, and Terminal Block:
 - e. Manufacturer and Model: Spectrum Controls 1769SC-IF4IH
2. Analog Output:
 - a. Outputs: 4 differential 4-20 mA (isolated) with HART communications
 - b. Resolution: 16-bit (unipolar)
 - c. Installation: PLC DIN rail. Provide all DIN rail and mounting hardware.
 - e. Manufacturer and Model: Spectrum Controls 1769SC-OF4IH
3. Discrete Input:
 - a. Inputs: 8 general purpose ON/OFF, 120 VAC (isolated). Each of the 8 inputs shall be capable of being addressed individually.
 - b. Installation: PLC DIN rail.
 - c. Manufacturer and Model: Allen-Bradley 1769-IA8I
4. Discrete Output:
 - a. Outputs: 8 isolated dry contact relay output. Contacts rated for 2 amps at 120 VAC. Install surge protection on all outputs and provide Allen-Bradley recommended parts.
 - b. Installation: PLC DIN rail
 - d. Manufacturer and Model: Allen-Bradley 1769-OW8I
5. All I/O modules shall be supplied with Allen-Bradley removable terminal blocks that plug into the front of the I/O module.
6. Provide minimum 20% spare installed I/O for each type of installed I/O.
7. Provide minimum 25% spare space on every DIN rail for future expansion.
8. All I/O, including spares, shall be wired to terminal blocks prior to interconnection with other devices. See Part II, Section 5.1 – Panel Construction;

Paragraph E.3, for terminal requirements.

9. Order with conformal coating (“K” designation) when available.

E. Software:

1. Provide a licensed copy of all programming and configuration software to the District, including electronic and hard copies of all manuals. The following software packages shall be furnished in addition to all other software necessary for the proper programming and configuration of the PLCs and their components:
 - a. RS Logix 5000
 - b. RS NetWorx for ControlNet
 - c. RS NetWorx for DeviceNet
 - d. RS Linx
 - e. FactoryTalk View ME

2.2.E - Rockwell Packaged CompactLogix with Embedded I/O

Detailed Specifications

A. Applications:

1. The Package CompactLogix series is used for applications such as the rain gauges.
2. Embedded I/O Capacity: Sixteen (16) 24 VDC discrete inputs, sixteen (16) 24 VDC discrete outputs.
3. Expansion I/O Module Capacity: minimum of two.
4. Installation: DIN rail.
5. Communication Ports: One (1) RS-232 serial port (DF1 or ASCII) and one (1) Ethernet I/P port.
6. Manufacturer and Model: Allen-Bradley Packaged CompactLogix 1769-L24ER-QB1B, or current model.
7. Programming Software: Rockwell RSLogix 5000. IEC 61131-6 compliant.
8. Order with conformal coating ("K" designation) when available.

B. Network Communications:

1. Ethernet I/P – use port on processor.

C. Power Supplies:

1. PLC Power:
 - a. Manufacturer and Model: Allen-Bradley 1769-PA4K.
 - b. Order with conformal coating ("K" designator) when available.
2. Field Devices: Provide power supplies to power field devices that require 24 VDC. Mount next to modules.
 - a. Input Voltage: 120 VAC, 60 Hz
 - b. Output Current: Sized for loads at 24 VDC with 25% spare capacity.
 - c. Provide cables and fusing
 - d. Manufacturer and Model:
 - 1) Allen-Bradley 1606-XLS Performance Series

D. I/O Requirements:

1. All I/O modules shall be supplied with Allen-Bradley removable terminal blocks that plug into the front of the I/O module.
2. Provide minimum 20% spare installed I/O for each type of I/O.
3. Provide minimum 25% spare space in every panel for future expansion.
4. All I/O, including spares, shall be wired to terminal blocks prior to interconnection with other devices. See Part II, Section 5.1 – Panel Construction; Paragraph E.3, for terminal requirements.

E. Software:

1. Provide a licensed copy of all programming and configuration software to the District, including electronic and hard copies of all manuals. The following software packages shall be furnished in addition to all other software necessary

for the proper programming and configuration of the PLCs and their components:

- a. RS Logix 5000
- b. RS Linx
- c. FactoryTalk View ME

2.2.F - Operator Interface Terminals (OIT):

Notes to specifier:

Operator Interface Terminals (OITs) shall be used as the interface to the process control system for a specific subsystem or particular process, as shown on the Contract Drawings or specifications. All OITs shall be functionally similar as to display arrangements, menu selections, command terminology, and data access methods. All OITs shall be programmed using the District-developed object library.

All OITs of a given type shall be functionally interchangeable differing only in the configuration installed on each type. All OITs shall be capable of accessing typical operator process control functions. Each OIT's functional environment shall be password-protected for system security and user identification. Required number of OITs provided shall be as shown or specified.

It is the District's intention to have the PLC/PanelView OIT Ethernet network separate from the PLC/HMI control Ethernet network. This requires multiple Ethernet modules in the PLC rack.

For new PanelView installations the PanelViews shall be 24 VDC powered and typically UPS backed-up. For replacement of existing 120 VAC PanelViews, consult the District.

Bid specifications must list the required display size for each application. The only approved display sizes are listed below.

Use the "Type A" OIT only for very large process systems or units and/or complex systems that require detailed graphics and overview screens. Use the "Type B" OIT for medium-sized processes or units with only moderately complex graphics and overview screens. Use the "Type C" OIT for small or simple processes or units. Typically used for small packaged or vendor-supplied panels.

All OITs shall be provided with conformally-coated electronics for the screens and logic modules. All specifications below shall be considered minimum requirements to allow for manufacturer improvements.

A. "Type A" OIT:

1. Manufacturer and Model: Allen-Bradley PanelView Plus 6 or latest series, catalog number 2711P-B15C4D9, without equal.
2. Display Screen Size: 15 inches, diagonally measured, backlit.
3. Resolution: 1024 x 768 pixels, 18-bit color graphics.
4. Display and Keypad Type: Touch screen and keypad.
5. Memory: 512 MB RAM and 512 MB nonvolatile flash memory.

6. Provide extended features and file viewers.
7. Supply Voltage: 24 VDC (see Note to Specifier).
8. Communications: Ethernet and RS-232.
9. Mounting: OIT shall be mounted on the front face of panel, as indicated on the Drawings.
10. Provide six (6) Allen-Bradley supplied protective overlays for screen and keypad.
11. Provide all cables, interface cards, local circuit breaker, and wiring.
12. Provide conformal coating of all circuit boards, including screen and logic module, when option is available.

B. “Type B” OIT:

1. Manufacturer and Model: Allen-Bradley PanelView Plus 6 or latest series, catalog number 2711P-B12C4D9, without equal.
2. Display Screen Size: 12.1 inches, diagonally measured, backlit.
3. Resolution: 800 x 600 pixels, 18-bit color graphics.
4. Display and Keypad Type: Touch screen and keypad.
5. Memory: 512 MB RAM and 512 MB nonvolatile flash memory.
6. Provide extended features and file viewers.
7. Supply Voltage: 24 VDC (see Note to Specifier).
8. Communications: Ethernet and RS-232.
9. Mounting: OIT shall be mounted on the front face of panel, as indicated on the Drawings.
10. Provide six (6) Allen-Bradley supplied protective overlays for screen and keypad.
11. Provide all cables, interface cards, local circuit breaker, and wiring.
12. Provide conformal coating of all circuit boards, including screen and logic module, when option is available.

C. “Type C” OIT:

1. Manufacturer and Model: Allen-Bradley PanelView Plus 6 or latest series, catalog number 2711P-B7C4D9, without equal.
2. Display Screen Size: 6.5 inches, diagonally measured, backlit.
3. Resolution: 640 x 480 pixels, 18-bit color graphics.
4. Display and Keypad Type: Touch screen and keypad.
5. Memory: 512 MB RAM and 512 MB nonvolatile flash memory.
6. Provide extended features and file viewers.
7. Supply Voltage: 24 VDC (see Note to Specifier).
8. Communications: Ethernet and RS-232.
9. Mounting: OIT shall be mounted on the front face of panel, as indicated on the Drawings.
10. Provide six (6) Allen-Bradley supplied protective overlays for screen and keypad.
11. Provide all cables, interface cards, local circuit breaker, and wiring.
12. Provide conformal coating of all circuit boards, including screen and logic module, when option is available.

2.2.G - Software and Programming:

- A. Contractors, system integrators and in-house programmers that perform work involving any portion of the District's process control system must first verify that they are working with the latest version of custom PLC control logic and all other custom and standard software as the basis for their control system augmentation, work. Verification of versions should be confirmed by District personnel.
- B. Provide the initial programming and system configuration for all PLCs, HMIs, OITs and servers required to make the system(s) function in accordance with the contract documents, subsequent control system and control strategy workshops, and submittal review comments. Provide electronic copies of all documentation describing the programming and database developed for the project including but not limited to:
 - 1. Control logic listings with detailed descriptions for each rung, function, module, etc.
 - 2. Register content tables
 - 3. System configuration information
 - 4. Other documentation as described herein.
- C. Provide updates to the software programming including all updated documentation to reflect all factory and field changes, modifications, system debugging, etc. required during design, factory testing, jobsite start-up, training, operational demonstration, and operation by District personnel up to and including the issue of the Certificate of Substantial Completion or the end of the Post-Commissioning Services period as applicable to the Project.
- D. The District's process control system Change Management and Version Control standards must be adhered to. Software and programming revisions, updates, and patches shall be continuously managed and documented through the duration of the project. The objective of version control and change management is to ensure that all programs reside in the equipment for which they are intended, and that those versions are properly authorized and up-to-date.
- E. Project software and programming version control shall be implemented using the District's Rockwell Software FactoryTalk AssetCentre application or other application acceptable to the District. When initial or revised versions of software are implemented, the person archiving the version shall include notations that identify the project name and number, program name, PLCs/OITs affected, software/program name, version number, name of person authorizing the version, name of programmer, version release date, description of the issues addressed by the version and version distribution/commissioning date. Refer to Sections 2.0 and 2.1 of the NEORSD Standard Object Library Guideline for additional details regarding software version control.
- F. Programming and software of PLCs and Operator Interface Terminals programmed

under the contract shall be fully compatible with one another and shall be developed using the RS Logix family series software by Allen-Bradley. Provide licensed copies of all programming configuration, system, vendor, and third party applications software to the District, for all control system software products provided under the Contract.

- G. Provide electronic and hard copies of all manuals.
- H. Refer to the PLC Standards sections for ControlLogix and CompactLogix for the required software.
- I. Licensed copies of all other software necessary for the proper programming and configuration of the PLCs and their components shall also be supplied.

References

- A. Reference Part II, Section 5.1, Panel Construction.

Installation Details

- A. Reference Part II, Section 5.1, Panel Construction
- B. The PLC and I/O racks shall be installed such that all LED indicators and switches are readily visible with the panel door open and such that repair and/or replacement of any PLC component can be accomplished without disconnecting any wiring or removing any other components.

Section 2.3 - Panel Wiring

This section provides the detailed requirements for the wiring of PLC panels. Included in this section are wire details as follows:

- A. Wire Types
- B. Color Standards
- C. Wiring Separation Distances
- D. Wire Tagging and Labeling
- E. Grounding

2.3.A - Wire Types:

1. Internal panel wiring shall be Type THHN stranded copper wire with thermoplastic insulation rated for 600 V at 85 C for single conductors, color coded and labeled with wire identification.
2. For internal panel DC signal wiring, use No. 18 minimum AWG shielded. For DC field signal wiring, terminal strips shall be capable of handling No. 12 wiring (minimum).
3. For internal panel AC power wiring, use No. 12 minimum AWG. For AC signal and control wiring, use No. 16 minimum AWG. For wiring carrying more than 15 amps, use sizes required by the NEC.

2.3.B - Color Standards

1. 120/208 Volt Systems (includes control power):
 - a. Hot: Black
 - b. Neutral: White
2. AC Control Wiring: Red
3. DC Control Wiring: Blue
4. Grounding Conductors: Green
5. All wiring not de-energized by the panel disconnect or circuit breaker shall be yellow wire.
 - a. For all panels containing wiring not de-energized by the panel disconnect or circuit breaker, provide a warning nameplate on the front of the panel stating "WARNING: YELLOW WIRING NOT DE-ENERGIZED BY PANEL DISCONNECT". The nameplate shall be amber with black ¼-inch high letter engravings and shall be attached to the panel face with stainless steel screws

2.3.C - Wiring Separation Distances

1. AC power wiring (120 volts and greater) and signal wiring shall be separated within the panel by the following distances. Signal wiring shall include control and monitoring wiring with voltage levels from 0 to 120 V AC/DC. Included are analog, discrete, bus (DeviceNet, Fieldbus, etc), and communications wiring (ModBus, Ethernet, etc.)

Separation Distances

Voltage	Current	Minimum Distance Between AC Power Wiring and Signal Wiring
0 to 125 volts	0 to 10 amps	12 inches
125 to 250 volts	1 to 50 amps	15 inches
250 to 480 volts	0 to 200 amps	18 inches

2.3.D - Wire Tagging and Labeling

1. Wires shall be identified at each end with permanent number codes.
2. Where practical, wire numbers shall be unique and continuous. Where wire numbers change, the appropriate drawings shall include both wire numbers, clearly indicated, at the point of transition.
3. Each wire number shall be solid, machine printed, and shall not be pieced from other single and/or double-digit tags.
4. Wire markers shall be heat, oil, water, and solvent resistant, vinyl, self-laminating, self-adhesive, wrap type labels as manufactured by the W.H. Brady Co. or approved equal.
5. All wire labels shall be clearly visible and not hidden by wire duct or other components in the enclosures.
6. PLC panel wire tagging shall be in accordance with Part IV Appendix Sections 1.0 and 2.0.

2.3.E – Grounding

1. Shields
 - a. Shields shall be connected to panel isolated ground bus. The isolated ground bus shall be attached to building steel.
2. Neutrals / Returns
 - a. Neutrals / returns shall be attached to terminal blocks which are connected to the panel neutral bus. The panel neutral bus shall be connected to the uninterruptible power supply.

Reference Standards

- A. Reference Part II, Section 5.1, Panel Construction

Installation Details

- A. Reference Part II, Section 5.1, Panel Construction

Section 2.4 - Panel Components

2.4.A - Power Distribution Terminal Blocks

1. Provide copper power distribution blocks according to drawings or sized to meet application. Provide Square D Class 9080-LBC series or approved equal. Provide clear plastic covers for terminal blocks to prevent incidental contact with terminals.

2.4.B - Terminal Blocks

1. Terminate all field wiring and internal panel wiring at screw type, feed-through terminal blocks. Provide gray terminal blocks unless otherwise specified or shown on drawings. Provide Allen-Bradley Catalog number series 1492-J* or approved equal. Adjust catalog number for wire sizes used. For example, for wire size range from 22 AWG to 10 AWG use Allen-Bradley Catalog No. 1492-J4 or approved equal.
2. Terminal blocks shall be UL/CSA approved with a 600 volt rating.
3. All terminal blocks shall have finger-safe terminals.
4. Mount terminals on rigid, high rise aluminum DIN rail. Use Allen-Bradley Cat. No. 1492-DR6 or approved equal.
5. Heavy-duty end anchors shall be provided on both ends of all terminal strips to firmly anchor the terminal blocks to the mounting rail and insulating end barriers shall be provided on one end of the terminal strip, as necessary.
6. No more than two wires shall be terminated at any single screw. Provide jumpers as required to join adjacent terminal blocks for additional wiring connection points.
7. All terminal blocks shall be labeled with alpha or numeric identifiers on each block. Identifiers shall be pre-printed snap-in marker cards.
8. Provide a separate terminal block for landing each analog signal cable shield.
9. Provide separate terminal strips with minimum physical separation for DC signal and AC power wiring. Maintain minimum physical separation between signal and power wiring. See Part 2, Section 2.3 for separation distances.
10. Provide spare terminal blocks equal in number to 20 percent of the terminals used for each type of wiring (for example, signal and power). Mount on DIN rail. Wire all spares from I/O card termination arms to the interposing terminal blocks.

2.4.C - Fused Terminal Blocks

1. Provide screw type, fused terminal blocks for all wiring powered from within panels or enclosures or to devices located outside the panel or enclosure. Provide black terminal blocks unless otherwise specified or shown on drawings. Fused terminal blocks shall be Allen-Bradley catalog number series 1492-H* or approved equal with blown fuse indication (LED preferred when available). For example, for 1/4" x 1 – 1/4" fuse size and 10 to 57 V AC/DC service use 1492-H5 with LED indicator and for 100 to 300 V AC service use 1492-H4 with Neon indicator or approved equal.
2. Fused terminal blocks shall be UL/CSA approved with a minimum 300 volt rating.
3. All terminal blocks shall have finger-safe terminals.

4. Mount terminals on rigid, high-rise aluminum DIN rail. Use Allen-Bradley Cat. No. 1492-DR6 or approved equal.
5. Heavy-duty end anchors shall be provided on both ends of all terminal strips to firmly anchor the terminal blocks to the mounting rail and insulating end barriers shall be provided on one end of the terminal strip, as necessary.
6. No more than two wires shall be terminated at any single screw. Provide jumpers as required to join adjacent terminal blocks for additional wiring connection points.
7. All terminal blocks shall be labeled with alpha or numeric identifiers on each block. Identifiers shall be pre-printed snap-in marker cards.
8. Provide separate terminal strips with minimum physical separation for DC signal and AC power wiring. Maintain minimum physical separation between signal and power wiring. See Part 2, Section 2.3 for separation distances.
9. Provide fuses (sized as required) and fuse pullers for all fused terminal blocks.
10. Provide 20 percent spare fused terminal blocks mounted on the rail(s). Wire all spares from I/O card termination arms to the fused terminal blocks.

2.4.D - Control Relays

1. Type: General purpose, plug-in type rated for continuous duty.
2. Performance and Construction Requirements:
 - a. Coil Voltage: 120 VAC or 24 VDC, as required.
 - b. Contact Configuration: Minimum DPDT with at least one spare contact. If 4PDT relay is required, then see Item # 4, below.
 - c. Contact Material and Rating:
 - 1) General Use: Silver or silver cadmium oxide contacts rated for 10 amps minimum (DPDT) at 120 VAC.
 - 2) Low Power Switching: Fine silver, gold flashed contacts specifically designed for low power switching, rated for 2 amps minimum at 30 VDC. Idec series RY or approved equal. Consult the Engineer.
 - d. Mounting: 8-Pin or 11-pin octal base plug-in sockets for sub-panel mounting on DIN rail. Sockets shall have screw terminals for wiring connections which shall accept a minimum of two #14 AWG wires. (Four pole relays as in paragraph #4, below, shall be supplied with a matching blade-style socket.) Sockets shall have finger-safe terminals.
 - e. Cover: Clear plastic dust cover.
 - f. Indication: LED indicator light.
 - g. Accessories: Hold-down spring or clip.
 - h. Accessories: MOV for DC voltage coil and MOVs for contacts, as required.
 - i. Accessories: MOV or zener diode for AC voltage coil, MOVs for contacts, as required.
 - j. Approvals: UL recognized.
3. Manufacturer and Model:
 - a. Tyco / Potter & Brumfield KRPA series.
 - b. Allen-Bradley 700-HA series
 - c. Magnecraft / Struthers-Dunn 750 series
 - d. Or approved equal.
 - e. Order with conformal coating when available.

4. Manufacturer and Model (If 4PDT relay required):
The following relays come with blade-style terminals:
 - a. IDEC RH4B series.
 - b. Magnecraft / Struthers-Dunn 784XDXM4L full-featured series.
 - c. Allen-Bradley 700-HC2 series.
 - d. Square D 8501RS series.
 - e. Or approved equal.
 - f. Order with conformal coating when available.

2.4.E - Timing Relays

1. Type: Programmable, multi-function, multi-range plug-in type time delay relay providing delay-on-make, delay-on-break and interval operation. Time shall be adjusted with a thumbwheel or digital display and not a rotary knob.
2. Construction Features:
 - a. Time range: 0.1 seconds or less to 9990 hours or more
 - b. Digital setting accuracy: Five percent or better
 - c. Contacts:
 - 1) Type: DPDT
 - 2) Rating: 10 Amp minimum
 - d. Housing: Plug-in design with dust and moisture-resistant molded plastic case.
 - e. Power input: 24 to 240 V AC or DC.
 - f. Operating Temperature: -10° C to +55° C.
 - g. Unit shall have LEDs or LCD to show timing status.
 - h. Sockets: 11-pin octal base to match relay. DIN rail mount. Sockets shall have screw terminals for wiring connections which shall accept a minimum of two #14 AWG wires. Sockets shall have finger-safe terminals.
 - i. Hold-down clips
 - j. Suppression diode or current snubber, as required
 - k. Approvals: UL recognized.
3. Manufacturer and Model:
 - a. Magnecraft TDRPRO 5100 series
 - b. Tyco / Potter & Brumfield CNT-35-96
 - c. Or approved equal.
 - d. Order with conformal coating when available.

2.4.F - Panel-Mounted Operators and Pilot Lights

1. All panel-mounted operators including, but not limited to, pilot lights, pushbuttons, selector switches, stations, specialty operators, and potentiometers shall be the NEMA 30.5 mm type.
2. Pushbuttons – General Purpose Areas
 - a. Nema 4X watertight & oiltight
 - b. Non-illuminated
 - c. Momentary contact unless otherwise specified
 - d. 1 N.O & 1 N.C. contact unless otherwise specified
 - e. Standard aluminum, Nema 4 grey legend plate unless otherwise specified

1. Manufacturer and Model:
 - a. Allen-Bradley 800H series
 - b. Or approved equal
- f. Nameplate, laminated plastic, black letters on white; text as specified
3. Pushbuttons – Hazardous (NEC classified) Locations
 - a. Nema 7/9 for Division 1 and Division 2 Areas
 - b. Non-illuminated
 - c. Momentary contact unless otherwise specified
 - d. 1 N.O & 1 N.C. contact unless otherwise specified
 - e. Standard aluminum, Nema 4 grey legend plate otherwise specified
 - 1) Manufacturer and Model:
 - a. Allen-Bradley 800H series
 - b. Or approved equal
 - f. Nameplate, laminated plastic, engraved black letters on white; text as specified

Pushbutton Styles and Colors

Function	Style	Operator Color
Start	Flush	Green
Stop	Extended	Red
Emergency Stop	Mushroom	Red
All Other Functions*	Flush	Black

*Unless otherwise specified.

4. Pilot Lights – General Purpose Areas
 - a. Nema 4X watertight and oiltight
 - b. Full voltage, push-to-test, LED lamp
 - c. Voltage to match application
 - d. Standard aluminum, Nema 4 grey legend plate unless otherwise specified
 1. Manufacturer and Model:
 - a.Allen-Bradley 800H series
 - b.Or approved equal
 - e. Nameplate, laminated plastic, engraved black letters on white; text as specified
5. Pilot Lights – Hazardous (NEC classified) Locations
 - a. Nema 7/9 for Division 1 and Division 2 Areas
 - b. Full voltage, push-to-test, LED Lamp
 - c. Voltage to match application
 - d. Standard aluminum, Nema 4 grey legend plate unless otherwise specified
 - 1) Manufacturer and Model:
 - a.Allen-Bradley 800H series
 - b.Or approved equal
 - e. Nameplate, laminated plastic, engraved black letters on white; text as specified.

Pilot Light Colors

Function	Color	Examples
Power	White	Panel power on, control power on

Status	Blue	In remote, In calibration
Alarm or Fault	Amber	VFD fault, low level, high pressure
Energized	Red	Motor or pump running, valve open
De-Energized	Green	Motor or pump stopped, valve closed

6. Selector Switches – General Purpose Areas
 - a. Nema 4X watertight and oiltight
 - b. Non-illuminated
 - c. Number of positions to suit application
 - d. Maintained or spring return to suit application
 - e. 2 N.O. and 2 N.C. contacts unless otherwise specified
 - f. Standard knob lever with black knob and white insert unless otherwise specified
 - g. Standard aluminum, Nema 4 grey legend plate unless otherwise specified
 - 1) Manufacturer and Model:
 - a. Allen-Bradley 800H series
 - b. Or approved equal
 - h. Nameplate, laminated plastic, engraved black letters on white; text as specified
7. Selector Switches – Hazardous (NEC classified) Locations
 - a. Nema 7/9 for Division 1 and Division 2 Areas
 - b. Non-illuminated
 - c. Number of positions to suit application
 - d. Maintained or spring return to suit application
 - e. 2 N.O. and 2 N.C. contacts unless otherwise specified
 - f. Standard knob lever with black knob and white insert unless otherwise specified
 - g. Standard aluminum, Nema 4 grey legend plate unless otherwise specified
 - Manufacturer and Model:
 - a. Allen-Bradley 800H series
 - b. Or approved equal
 - h. Nameplate, laminated plastic, engraved black letters on white; text as specified

Reference Standards

- A. Reference Part II, Section 2.1, Panel Construction and Part II, Section 2.2, PLC Hardware & Software.

Installation Details

- A. Reference Part II, Section 2.1, Panel Construction.
- B. The PLC and I/O racks shall be installed such that all LED indicators and switches are readily visible with the panel door open and such that repair and/or replacement of any PLC component can be accomplished without disconnecting any wiring or removing any other components.

SECTION 3 - PLC PROGRAMMING STANDARDS

Section 3.0 - Introduction

With over 50 PLCs deployed at one plant alone, it is not possible for an individual to retain detailed knowledge about all the PLCs in place. Standard ranges and schemes are necessary to keep some uniformity among the ladder logic and files. Almost all PLCs have some control outputs; very few are used only for monitoring.

Section 3.1 - Allen Bradley PLC 5 Programming Conventions

Almost all plant process PLCs are Allen-Bradley PLC-5, and all that are connected to the Control Network are Ethernet processors, e.g., PLC 5-60E. Data Highway+ cabling is used to connect remote I/O and a small amount of Flex I/O to the processors. Extended I/O is not used. Future purchases of new PLC equipment (not add ons to existing PLC 5s) will be Rockwell ControlLogix.

3.1.A - I/O Ranges

I/O addresses are fixed by A-B rack numbers and slot numbers. Inputs are usually arranged in the lower racks, with digitals preceding analogs. Complementary I/O is not to be used. I/O is arranged to concentrate related inputs or outputs on single cards so that an I/O card failure will affect only one or two pieces of equipment, i.e., all start/stop/run/fail signals for a given pump are on the same card. However, spare or backup equipment shall be entirely wired to separate I/O cards to avoid losing both pieces of equipment if there is an I/O card failure. In most cases, spare inputs and outputs are designed in.

Thorough annotation is required for I/O rack numbers as part of the program documentation. In existing PLCs, an operator interface often takes a rack number in the middle of remote I/O rack numbers.

3.1.B - Block Transfer Ranges

Several types of block transfers are used, a) analog inputs, b) remote or flex I/O transfers, c) data transfers from other PLCs and operator interfaces. Polling files are discussed in a different section.

Analog input transfers, remote I/O, and flex transfers are generally transferred to file BT:0 and up. Thorough annotation is required. Transfers to operator interfaces do not have standard files, but must be thoroughly annotated. Internal ladder transfers are as required.

3.1.C - HMI Polling Files

Data to be polled by the HMI system is transferred to the N:80 file. If there is an existing PLC that already has an N:80, N:180 is used. The data is aggregated to minimize network traffic, since the data can be read contiguously. Analog values in general are posted to the transfer file as 0-4095 values with scaling done at the HMI server. Double-precision values are posted to the F:8 file. Control outputs from the HMI system are sometimes posted to the B:3 file, but must be thoroughly annotated.

3.1.D - Remote I/O Addressing

Remote I/O rack addressing is not standardized. Thorough annotation is required.

3.1.E - Flex I/O Addressing

Flex I/O is used very little at this time. Addressing is not standardized so thorough annotation is required.

3.1.F - Software

Allen-Bradley RSLogix 5, RSLogix 500, RSLinx, and PanelBuilder software from Rockwell Automation are used exclusively for programming and building interfaces. The software package and its application are listed below:

<u>Software</u>	<u>Application</u>
RSLogix 5	PLC-5 programming
RSLogix 500	SLC 500 series programming
RSLinx	View active networks and run multiple applications
PanelBuilder	PanelView HMI configuration

Third party applications, such as Taylor software, are not to be used.

New PLC programs or modifications to existing PLC programs shall be executed using software compatible with existing development software used by the NEORSD. New or modified programs developed for the NEORSD using versions of software that are later than versions of software owned by the NEORSD shall be unacceptable. It shall be the responsibility of the programmer to determine the existing version of development software used by the NEORSD.

Contractor's integrator shall contact the plant electrical-instrumentation (EIT) manager or ***the District Manager of Process Control and Automation*** to acquire the latest copy of the affected PLC program to be modified under the integrators contract responsibility. All program modification that involves new hardware or system add-ons shall be done in a separate subroutine. Each rung shall be described as to function, and each element in the rung shall have a description. If modifications to existing equipment in the system are part of the integrators responsibility, the modifications shall be done in the existing subroutine. Each rung shall be fully described, and each element in the rung shall have a description. NEORSD-provided tag names or naming conventions shall be used.

Any additions to the I/O subsystem shall have the element added to the I/O configuration portion of the RSLogix software. As program changes are made, the daily-modified software shall be presented in soft copy to the plant EIT manager. When program modifications are complete, the software in soft copy shall be presented to the plant EIT manager as well as ***the District Manager of Process Control and Automation***.

Section 3.2 - Allen-Bradley SLC 500 Programming Conventions

SLC 500 PLCs will follow PLC-5 conventions, but are not in use currently except as part of equipment packages. The District is evaluating installation of SLC 500s at collection system sites. RSLogix 500 software will be used.

All new PLCs purchased will be Rockwell ControlLogix.

Section 3.3 - Allen Bradley Operator Interface

Allen-Bradley Color LCD PanelView Plus 6 graphic terminals must be used for non-HMI operator interface terminals (OIT).

The PLC/OIT network shall be separated from the PLC/HMI control network. This will require multiple Ethernet modules in the PLC rack.

Since models change with relative frequency, **contact your NEORS D project manager for information regarding PanelView specifications.**

Transfer Ranges To/From PLC (PLC5/SLC500 Only)

Operator Interface rack addressing is not standardized. Thorough annotation is required.

Software

Panel Builder from Rockwell Automation is required for applications programming. Thorough documentation and annotation is required.

Section – 3.4 - Other PLC Programming Conventions

Section to be completed if the District retains the few other PLCs it has (General Electric, Modicon).

(Contact ***the District Manager of Process Control and Automation*** if reprogramming of existing GE PLCs is required)

Section 3.5 - Analog Rounding/Truncation Logic

3.5.A - General

Truncating logic provides a standard method for indication with a set resolution, and storage of a logged value into the data warehouse used for reporting.

All analog (unit of measure) values need to be in the form of a REAL type or “Float” for the HMI system. The PLC5 defines a float [by default]

F8 Floating Point	This file stores a # with a range of 1.1754944e-38 to 3.40282347e+38
-------------------	--

It’s this expansive precision, that when passed through the various systems, can result in unpredictable rounding and trailing digits. The value stored in one database or warehouse may not exactly match another or the raw data. Due to the amount of stored data and the duration of queries performed against the data, these seemingly slight differences have a large impact on reports’ final values.

The solution is limiting the precision (Truncating) at the original point source of the signal or calculation within the Programmable Logic Controller (PLC). The logic presented here is standard for SLC and PLC5 legacy platforms; the ControlLogix PAC platform does not require truncating logic. There are three methods of logic used to accomplish the truncating operation:

The most common is defined in Table 1.a. This is used when the intermediate integer value has a scaled range under 32767.

The second most used is defined in Table 1.b. This is used when whole numbers, or integers, with no precision are to be logged to the data warehouse.

The third is defined in Table 1.c. This is used when the intermediate integer value has a scaled range exceeding 32767.

The PLC5 defines an integer [by default] as having only 15 useable bits to the word and the 16th determining the sign +/- of the value.

N7 Integer	This file is used to store bit information or numeric values with a range of -32767 to 32768.
------------	---

3.5.B - Background

Process variables from various sources in SCADA, such as a PLC, which are used for data analysis in existing and upgraded databases as presented to the SCADA system, have consistency errors during data analysis.

Process variables, when stored historically with a long number of digits after the decimal point, are in fact interpreted differently by various platforms and users. These interpretations whether automated or user directed present rounding errors when converting between platforms.

Overall these data analysis errors create reporting discrepancies. These errors can end up being significant over a long period of time. In other words, two users can interpret the identical data differently.

It has been determined that limiting process variables at the HMI level is not possible. The displayed value can be limited but the background raw data value used for reporting is always the full floating point value.

3.5.C - General Solution

The solution is to promote the use of defined process variable precision at the local level and then propagate the process variable up through the SCADA hierarchy. This process uses the same value as a consistent reference across all SCADA systems including control, monitoring, historical and reporting from the base PLC level and up. The value, once defined in the PLC, will be used as follows:

- PLC Process Variable, within PLC for all PLC process control logic including process calculations and messages between PLCs.
- OIT Process Variable, for display in the local PLC monitoring and control equipment.
- HMI Process Variable, for display in SCADA monitoring and control equipment
- Historical Process Variable, for storage in historical database.
- Reporting Process Variable, for reports from historical databases.

The process variable with defined precision will be referred to as the Truncated Value herein.

This truncation logic is specific for PLC5s, but can be converted for use with ControlLogix PLCs into the form of an AOI. Essentially the PLC5 logic described herein functions similarly to an AOI.

Rounding built into the truncation logic is based on IEEE 754-2008 standard practices for rounding.

The PLC5 logic uses a subroutine with passed parameters and a returned value. There is no indirect addressing which can lead to overlapping registers which would produce “junk” data. The logic is designed to process all numbers without creating PLC overflows or errors. The logic design prevents errors by checking the variables against defined limits.

3.5.D - Implementation

The logic is implemented in three steps for integrators to follow when applying the Truncated Value logic.

Step 1: Configure two data files

N700 – ROUNDING_I provide with 10 words
F800 – ROUNDING_F provide with 10 words

Use the predefined words in the truncating logic standard which will, on import, fill their descriptions into the N700 and F800 data files.

ROUNDING_I	700	N	Global	No	10/10	N700:9
ROUNDING_F	800	F	Global	No	20/10	F800:9

Table 1

Step 2: Insert Rounding Program

The logic will be standard and is to be used in all PLC5s implementing this Truncated Value solution. The logic will be its own subroutine. Create a new program file, whichever is the next available (the file number is irrelevant), but it must be the last in the program files. Call the new program file “FL_ROUND.” Import the truncating logic into the newly created ladder program. Once the new program file is created the JSR block parameter for jumping to the truncating logic can be set. All subsequent JSRs for the truncating logic in the PLC program will now reference this new program file.

Note: The PLC5 inherent logic converts any number above 9,999,999.0 to an exponent number. For example the number 10,000,000 is automatically converted to 1E7. Similarly, for negative numbers, the number -10,000,000 is automatically converted to -1E7. These numbers are passed through the truncating logic input to output. These limitations can be prevented by understanding your data and the data’s potential range.

MO_PM-810E	50	Ladder File	11	No	393	70
INGATES_QA	51	Ladder File	31	No	804	133
INGATES_QB	52	Ladder File	31	No	824	138
INGATES_QC	53	Ladder File	31	No	824	138
INGATES_QD	54	Ladder File	31	No	811	134
N80	67	Ladder File	116	No	2856	354
CSOTF FIFO	69	Ladder File	67	No	5238	723
GAS_DETECT	70	Ladder File	28	No	526	79
FL_ROUND	71	Ladder File	15	No	400	51

Next program
ladder available.

Table 2

Note: **DO NOT INSERT IF THERE ARE OPEN PROGRAM FILES!**

FT_ROUND SHALL BE THE LAST PROGRAM FILE WHEN ADDED TO THE PROGRAM.

Step 3: Insert JSR program blocks

The Jump to Subroutine (JSR) block is positioned after an analog scaling compute block. This truncating logic standard does not cover or replace the scaling practices in the compute block.

A scaling compute block will produce a float which is the raw unrounded floating point value. The scaling compute block output is to be used as the truncating subroutine input. The scaling compute block floating point number is to have at the end of its description the text “RAW” to identify it as the unrounded process variable. For example, description is “Raw Sewage Wet Well Level 0-30 FT (RAW)”

The scaling and truncating is expected to be performed before transfer to the Program file N80 – HMI program file for consistency.

The Jump to Subroutine block is a two input and one output block.

Input 1 (FLOAT_IN): The RAW real floating point number (Unrounded)

Input 2 (DEC_RIGHT): Desired amount of digits to the right of the decimal point.

Output 1 (FLOAT_ROUNDED): Rounded Floating Point number (Truncated Value)

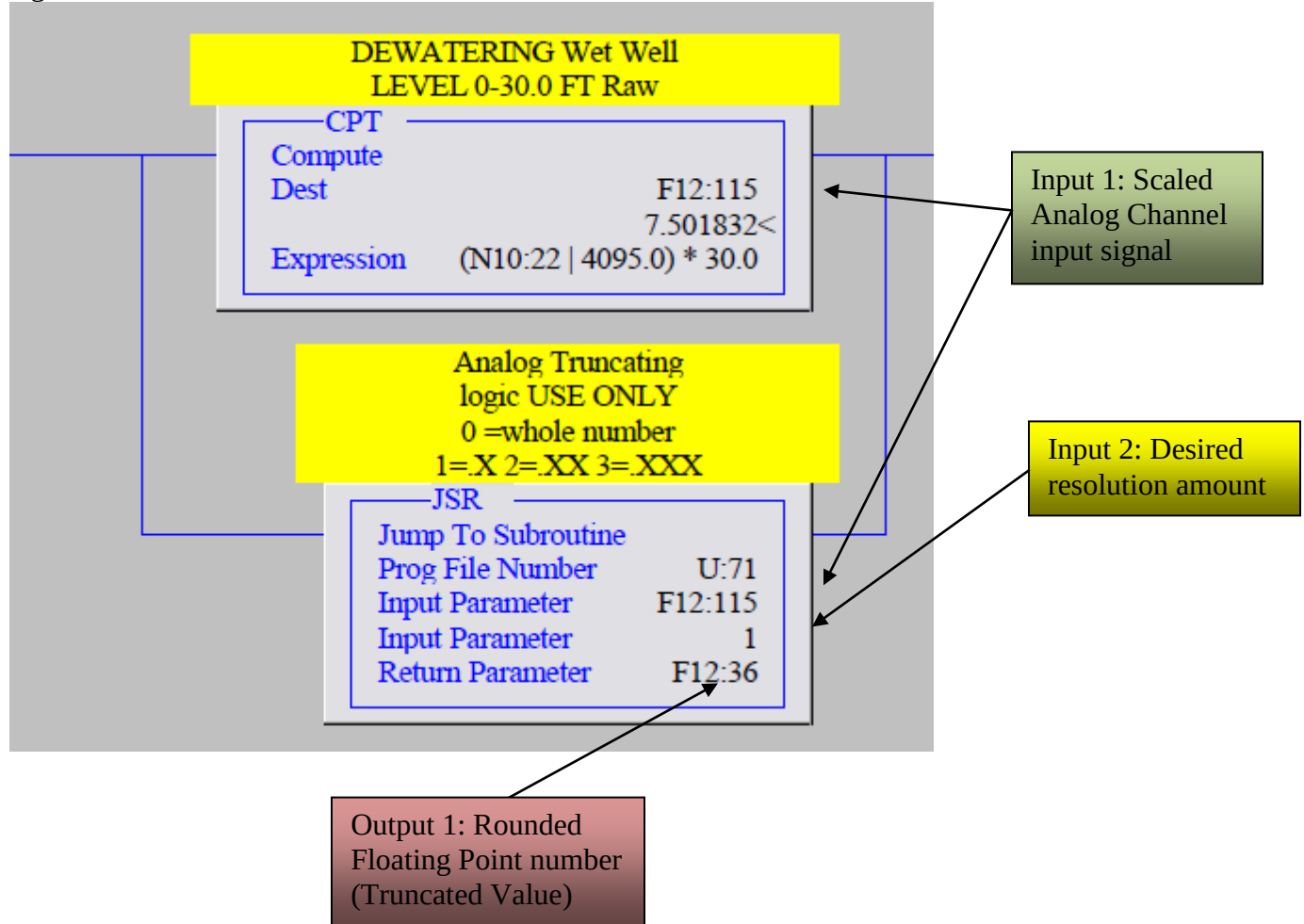
There is one additional parameter, the program file number. The program file number is assigned according to directions in Part 2.

For Input 2, the Truncated Value only has four choices allowed for rounding. Any numbers used outside of these for numbers will default back to these numbers. For example, if “-3” is entered the program will operate as if a “0” was set at the input. The same goes for numbers greater than three. For example, if “12” is entered. The program will operate as if a “3” was set as the input. For standard programming only use the following values:

- “0” returns a whole number. i.e. 7.501832 returns 7
- “1” returns one digit to the right of the decimal point. i.e., 7.501832 returns 7.5
- “2” returns two digits to the right of the decimal point. i.e. 7.501832 returns 7.50
- “3” returns three digits to the right of the decimal point. i.e. 7.501832 returns 7.502

The Output is self explanatory and is the desired result for the defined process variable and desired precision level. The description of the truncated value will be, following our example from above, “Raw Sewage Wet Well Level 0-30 FT”, see Figure 1 below.

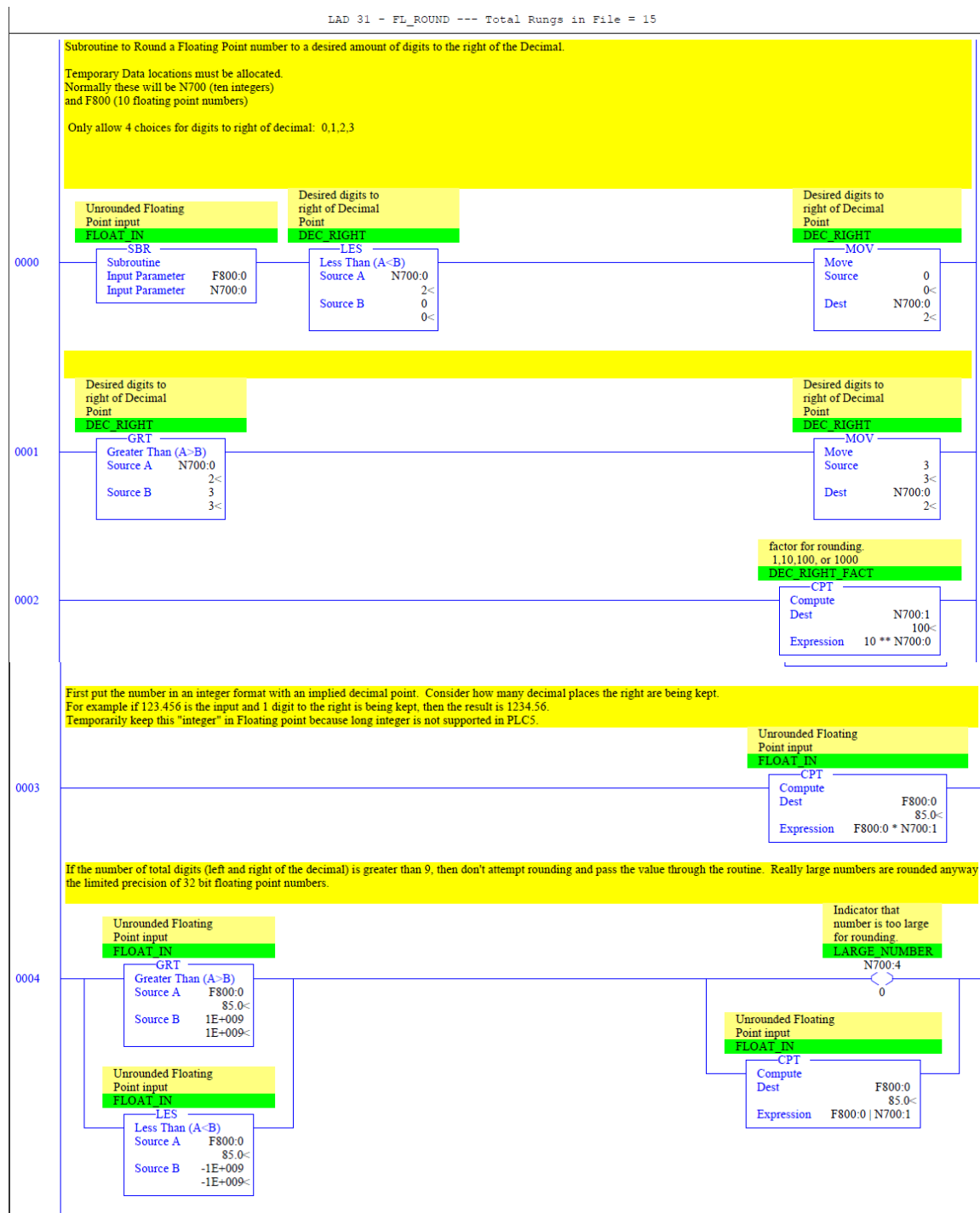
Figure 1

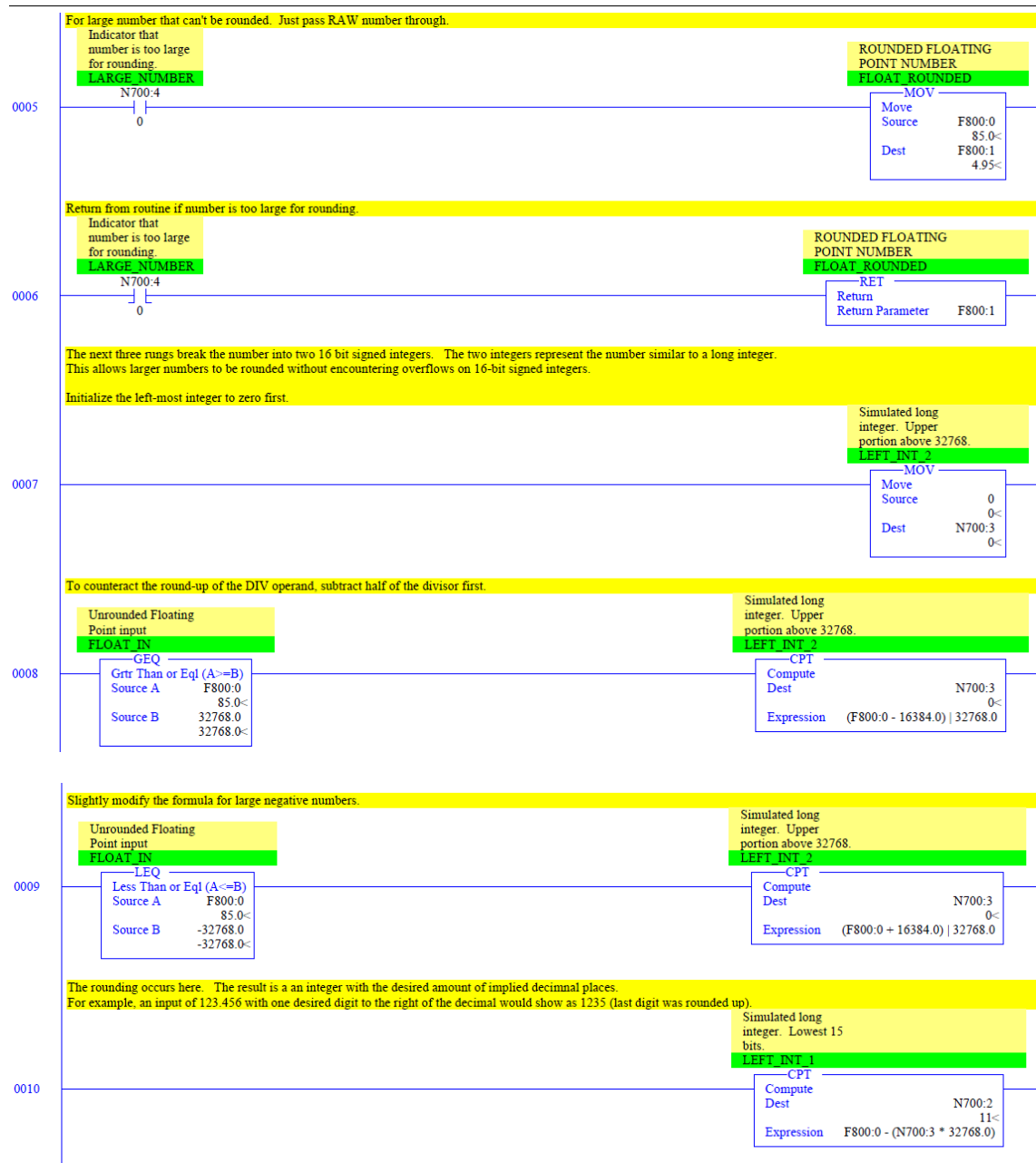


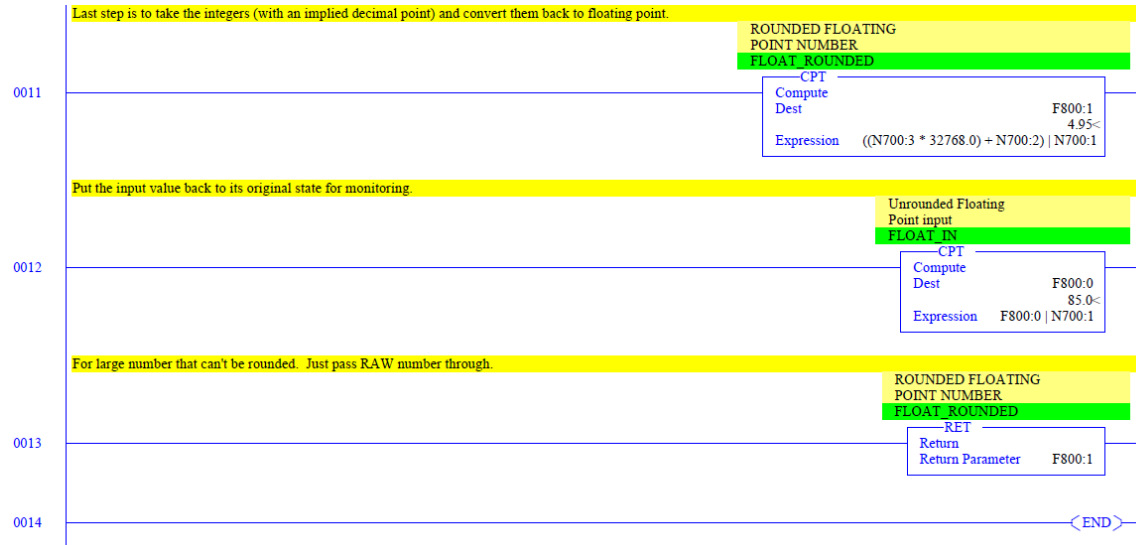
Note: **ALL CONTROL LOGIC SHALL USE OUTPUT 1 ONLY.** Additional CPT and logic block may be used as long as “Output 1” is referenced and not “Input 1”.

3.5.E - Ladder Logic – Printed

Below is the printed truncation ladder logic for reference. This code is available from the NEORS D; contact your project representative for more details.







SECTION 4 - COMPUTER HARDWARE

Section 4.0 - Introduction

The majority of computer hardware is consistent across viewers, servers, historians and domain controllers. Differing power supply and hard drive configurations have been implemented for the servers. The computers can hold two microprocessors, although only one is installed.

Section 4.1 - Area Control Stations (ACS, Viewer)

This section provides the detailed requirements for an ACS. An ACS includes the following:

- A. Computer System
- B. Monitor
- C. Keyboard
- D. Enclosure

Detailed Specifications:

4.1.A - Computer System

1. The computers are Compaq Proliant 1600 and have the following components:
 - a. Pentium II microprocessor (450MHz)
 - b. 9.1Gb SCSI hot-swappable hard drive in sled
 - c. Motherboard-mounted SCSI controller and IDE controller
 - d. Motherboard-mounted Ethernet card, Netelligent 10/100 TX
 - e. Matrox G200 video card
 - f. 128Mb RAM
 - g. CD ROM drive
 - h. Floppy drive
 - i. Single power supply

Please note that computer specifications change several times a year as options are changed or upgraded. **This equipment list is correct only at the time of writing. If any computers are to be procured, please contact the *District Manager of Process Control and Automation* for current specifications.**

4.1.B - Monitor

1. The monitors for all operator stations are LCD screens. 18" screens are used in the ACS cabinets. The longevity and minimal heat dissipation are key factors.
2. Manufacturer: NEC
3. Model: Multisync LCD 1810

4.1.C - Keyboard

1. Hard use keyboards are installed at all operator stations, with an integral pointing device. The keyboard and pointing device are electrically separate; if one fails the other may be used to continue operating until repairs can be made. The keyboard is sized to fit in the drawer of the stainless steel cabinet.
2. Manufacturer: Texas Industrial Peripherals
3. Model number: DT-5K

4.1.D - Enclosure

1. A NEMA 4X stainless steel enclosure with window for the screen and a sealable, pull out keyboard drawer is used for almost all ACSs.
2. Enclosure shall be lockable using a keyed lockset. All access openings that are screwed/bolted closed shall use security screws that require a special tool to remove.
3. Manufacturer: Hoffman, or approved equal.

4.1.E - Installation Details

This section does not contain all installation details for the equipment/ system shown, only those that are required by the NEORS D. These details may exceed those required by the equipment manufacturer or local codes.

Area Control Stations

Installation details: Use separate flexible conduits to connect network cables, UPS power, and normal power. Monitor shelf must be set to center the monitor in the window. Power and network outlets use single-gang boxes mounted to the cabinet.

Section 4.2 - Area Control Station/Servers (ACS/S)

This section provides the detailed requirements for an ACS/S. An ACS/S is an array consisting of two (2) computers, installed in a locking cabinet under a counter or desk set to hold the two monitors. The ACS/S are configured as a redundant server pair in the HMI software and have communications that will enable data to be served from the redundant if the primary fails. An ACS/S includes the following:

- A. Computer System
- B. Monitor
- C. Keyboard
- D. Enclosure

Detailed Specifications

4.2.A - Computer System

1. The computers are Compaq Proliant 1600 and have the following components:
 - a. Pentium II microprocessor (450MHz)
 - b. Three 9.1Gb SCSI hot-swappable hard drives in sled
 - c. Smart Array 3200 RAID SCSI controller
 - d. Motherboard-mounted SCSI controller and IDE controller
 - e. Motherboard-mounted Ethernet card, Netelligent 10/100 TX
 - f. Matrox G200 video card
 - g. 256Mb RAM
 - h. CD ROM drive
 - i. Floppy drive
 - j. Redundant power supplies (three in hot swap configuration)

Please note that computer specifications change several times a year as options are changed or upgraded. **This equipment list is correct only at the time of writing. If any computers are to be procured, please contact the District Manager of Process Control and Automation for current specifications.**

4.2.B - Monitor

1. The monitors for all operator stations are LCD screens. 20" screens are used in the ACS cabinets. The longevity and minimal heat dissipation are key factors.
2. Manufacturer: NEC
3. Model: Multisync LCD 2010

4.2.C - Keyboard

1. Hard use keyboards are installed at all operator stations with an integral pointing device. The keyboard and pointing device are electrically separate; if one fails the other may be used to continue operating until repairs can be made. The keyboard is sized to fit in the drawer of the stainless steel cabinet.
2. Manufacturer: Texas Industrial Peripherals
3. Model number: DT-2000-PS2

4.2.D - Enclosure

1. A lockable enclosure sized for the two CPUs and network hardware. Monitors to be mounted remotely with keyboards.

4.2.E - Installation Details

This section does not contain all installation details for the equipment/ system shown, only those that are required by the NEORSD. These details may exceed those required by the equipment manufacturer or local codes.

A. Area Control Stations/Servers

1. Installation details: use separate flexible conduits to connect network cables, UPS power, and normal power. Power and network outlets use single-gang boxes mounted to the cabinet.

Section 4.3 - Historians and Domain Controllers

This section provides the detailed requirements for a historian and domain controller. There are currently two historians and one domain controller per plant. They are not accessed directly by operators and are for database and administrative functions only. A historian and domain controller include the following:

- A. Computer System
- B. Monitor
- C. Keyboard
- D. Enclosure

Detailed Specifications

4.3.A - Computer System

1. The computers are Compaq Proliant 1600 and have the following components:
 - k. Pentium II microprocessor (450MHz)
 - l. Three 9.1Gb SCSI hot-swappable hard drives in sled
 - m. Smart Array 3200 RAID SCSI controller
 - n. Motherboard-mounted SCSI controller and IDE controller
 - o. Motherboard-mounted Ethernet card, Netelligent 10/100 TX
 - p. Matrox G200 video card
 - q. 256Mb RAM
 - r. CD ROM drive
 - s. Floppy drive
 - t. Redundant power supplies (three in hot swap configuration)

Please note that computer specifications change several times a year as options are changed or upgraded. This equipment list is correct only at the time of writing. **If any computers are to be procured, please contact the *District Manager of Process Control and Automation* for current specifications.**

4.3.B - Monitor

1. 17" CRT monitors are used for these computers. Minimum resolution of 1280x1024 and a tight dot pitch are required.
2. Manufacturer: Mag or Compaq
3. Model: Mag 720V or Compaq P75

4.3.C - Keyboard

1. Standard Compaq keyboards and mice are used with these computers.

4.3.D - Enclosure

NA

Section 4.4 - Printers

This section provides the detailed requirements for printers. There are currently three types used—report, alarm, and graphics printers (two versions of graphics printers). ***See the District Manager of Process Control and Automation for the current requirements and model numbers.***

Detailed Specifications

4.4.A - Report Printer

1. A high durability 600-dot laser printer is required. Print rate is 17 pages/minute. An optional feed tray is attached. An internal MIO card with Ethernet connection provides connectivity.
2. Manufacturer: Hewlett-Packard
3. Model number: Laserjet 5000N

4.4.B - Alarm Printer

1. A high durability 360x360 dot matrix printer is used. Greenbar tractor feed paper is required for logging. There is also an integral Ethernet 10/100 connection.
2. Manufacturer: Epson
3. Model number: DFX-5000

4.4.C - Graphics Printer

1. A color inkjet printer is used for screen and trend graph printouts. The printer has an internal Ethernet module.
2. Manufacturer: Epson
3. Model number: Color Stylus 900N

4.4.D - Mid-size Format Graphics Printer

1. A mid-size (up to C size paper) color inkjet printer used for screen and trend graph printouts during development. An external HP print server is used to provide network connectivity.
2. Manufacturer: Epson
3. Model number: Color Stylus 3000

SECTION 5 - SOFTWARE

Section 5.0 - Introduction

The reader should be aware that software versions are patched and otherwise changed at intervals as little as weeks. The versions listed below are accurate at the time of writing. If any software is to be procured, please contact ***the District Manager of Process Control and Automation*** for current specifications.

Section 5.1 - Computer / Network Operating System

The operating system was chosen in tandem with the HMI software. The HMI software chosen runs only on Microsoft Windows 95/NT at the time of writing. Since the system was required to use NT Server, the NT domain model was used for the network. A single domain model was used with the domain master at Southerly and domain backups at Easterly and Westerly. This scheme along with the IP numbering scheme will allow the entire Control network to be treated as a single entity when connected by a wide area network. The network is currently administered as separate networks with intermittent communication between domain servers to synchronize files, services, and so on.

We are planning to upgrade to Windows 2000 when a version of Cimplicity becomes certified for use with it. That said, it should also be noted that upgrades and service packs are not applied without evaluation. Unless there is a defined benefit to move to a certain version or patch level, the adage “if it ain’t broke, don’t fix it” holds.

At this time (2013), the GE Cimplicity HMI software is being replaced District-wide with Wonderware HMI. See *the District Manager of Process Control and Automation* for the latest developments.

5.1.A - Requirements

The operating system software for the Control network computers is Windows NT 4.0, currently patched to service pack 4. NT Server is used for the domain server, Oracle application servers, and ACS/S Cimplicity servers. NT server was required because of the potential for more than 10 computers to be communicating with the server at one time. NT Workstation is used for ACS viewers.

1. Manufacturer: Microsoft
2. Model number: Windows NT Server, Windows NT Workstation
3. Installation details: NEORSD personnel have a detailed procedure and have saved partition images which can be used to load servers or workstations. Contact ***the District Manager of Process Control and Automation*** if this work needs to be done.

5.1.B - Group Management

The NT user management tools such as profiles and policies make it practical to manage users in groups. In addition to the normal groups (administrators, backups, users, etc), there were two groups added, HMI users (configuration team members), and HMIOpers (operators). The HMI users are given broad permissions since they configure computers and make changes to systems. The network administrator id and local administrator ids are separate. HMIOpers are guest-level network ids that have the interface shell set to the Cimplicity HMI viewer application and are thoroughly restricted.

5.1.C - Security Measures

Several security practices are used, including limitations on file permissions, operator interface shell substitution, custom policies and profiles, and network permission limitations. A minimum of 6 characters is required for passwords.

Section 5.2 - Drivers / Utilities Software

5.2.A - ODBC Database Drivers

A third party ODBC driver was required for the interface between Oracle 8 and Cimplicity 4.01. Merant (formerly Intersolv) ODBC drivers are installed on each computer.

1. Manufacturer: Merant Data Systems
2. Part number: Merant Data Direct 3.50 for Oracle 8, patched to 3.50.0014
3. Installation details: NEORS D personnel have a detailed procedure for loading and configuring this software. **Contact the District Manager of Process Control and Automation if this work needs to be done.**

5.2.B - Hardware Drivers

Several hardware drivers are in use for varying hardware. A list follows. As with the other software, NEORS D personnel have a detailed procedure for loading and configuring this software. **Contact the District Manager of Process Control and Automation if this work needs to be done.**

1. Compaq Configuration Utility, 4.21
2. Compaq Array Driver / Compaq 2DH Array controller (older)
3. Compaq SmartArray 3200 controller
4. Compaq Netelligent network card driver
5. Matrox Millennium II NT driver (older)
6. Matrox G200 NT driver
7. Compaq power supply viewer
8. Compaq driver for HPC1537A 4mm DAT tape drive
9. Other drivers are in use

5.2.C - Anti-Virus Software

The NEORS D standard anti-virus software is Symantec Norton Anti-Virus (NAV). The control network uses the anti-virus solution version since it is made for a networked environment. **See**

the District Manager of Process Control and Automation for the latest requirements and version.

1. Manufacturer: Symantec
2. Model number: Norton Anti-Virus Solution 4.0
3. Installation details: NEORS D personnel have a detailed procedure for loading and configuring this software. Virus definitions are updated regularly and are checked during the login process. **Contact the District Manager of Process Control and Automation if this work needs to be done.**

5.2.D - Printer Drivers

Printer drivers are used for 4 types of printers:

1. HP Laserjet 5000N – Hewlett-Packard PCL 5 driver
2. Epson DFX 5000 – Epson DFX driver
3. Epson Stylus Color 900N – Epson color printing system 3.02
4. Epson Stylus Color 3000 – Epson Stylus Color 3000 driver

5.2.E - Intranet Browser

The Intranet browser is currently not enabled.

5.2.F - Backup Software

Back-up is performed by CA Arcserve IT using the client agents for NT and Oracle and the open file agent. Backups are currently initiated manually, but will be scheduled regularly after a tape changer is procured.

1. Manufacturer: Computer Associates
2. Model numbers: Arcserve IT, version 6.61
3. Client Agent for Windows NT, 6.61
4. Backup Agent for Oracle 8, 6.61
5. Backup Agent for open files, 6.61
6. Installation details: NEORS D personnel have a detailed procedure for loading and configuring this software. **Contact the District Manager of Process Control and Automation if this work needs to be done.**

5.2.G - PLC Communications Drivers

Almost all PLCs are Allen-Bradley PLC-5's. GE Cimplicity uses the RS-Linx driver from Rockwell Software (and a Cimplicity module in some cases) to communicate with the PLCs.

1. Manufacturer: Rockwell Software
2. Model number: RS-Linx OEM (for ACS/S), 2.10.18
3. RS-Linx full version is used for some development, version 2.10.18
4. There are also GE PLCs attached to the network. No driver software is required for this communication protocol.
5. There are Modicon PLCs that will be attached to the network. These will not require a separate driver for the Modbus communications protocol.
6. Installation details: NEORS D personnel have a detailed procedure for loading and configuring this software. **Contact the District Manager of Process Control and Automation if this work needs to be done.**

Section 5.3 - HMI Software

The HMI software is currently under review for replacement. Contact the District Manager of Process Control and Automation for more information.

Cimplicity HMI is used for all human-machine interface (HMI) applications.

5.3.A - Base Product

The base product has all polling, data manipulation, trending, and presentation functions. A complete software load is performed on all stations with licensing determining the functions allowed on a given station.

1. Manufacturer: General Electric
2. Version number: Cimplicity HMI 4.0, patched to version 4.01 service pack 3 (4.03)
3. Model numbers: Full Point I/O Development System – IC646TDV000
4. Full Point I/O Runtime System – IC646TRT000
5. Viewer Runtime System – IC646TRT999
6. Installation details: NEORSD personnel have a detailed procedure for loading and configuring this software. Contact ***the District Manager of Process Control and Automation*** if this work needs to be done.

5.3.B - Additional Applications Modules

Additional application modules provide SPC, pager functions, and server redundancy functions. For development stations, an Allen-Bradley connectivity module is also required. An ACS/S server pair requires server redundancy to enable fail over.

1. Manufacturer: General Electric
2. Model numbers: Statistical Process Control – IC646NSP000
3. Cimplicity Pager – IC646NPG000
4. Server Redundancy Option – IC646NHR000
5. Allen-Bradley Communications – IC646NEA000
6. Installation details: NEORSD personnel have a detailed procedure for loading and configuring this software. Contact ***the District Manager of Process Control and Automation*** if this work needs to be done.

Section 5.4 - Relational Database

Note: The Cimplicity HMI software is being replaced District-wide with Wonderware HMI. Contact *the District Manager of Process Control and Automation* for the latest developments.

The NEORSD standard relational database is Oracle. The Cimplicity HMI software requires an external database for trending and some historical functions. Rather than deploy multiple small databases and maintain them, one larger redundant database per plant was set up to meet the Cimplicity database needs. It must be redundant because the Cimplicity redundancy requires separate database names and tables for its primary and redundant servers.

5.4.A - Base Product

Oracle 8 (not 8i) is installed on the control network historians and the information network ODMS database server.

1. Manufacturer: Oracle
2. Model number: Oracle Enterprise Edition 8.05.0.0
3. Installation details: NEORSD personnel have a detailed procedure for loading and configuring this software. **Contact *the District Manager of Process Control and Automation* if this work needs to be done.**

5.4.B - Interface to ODMS

Data is passed to the ODMS system via SQL (PL-SQL) calls made from the ODMS to the historian(s). In many cases, a selection of data is evaluated on the historian and the result is returned to the ODMS system to limit the amount of data traffic. The ODMS and historians communicate across a network router set to allow only those PCs to communicate across it.

5.4.C - Interface for HMI Trends

Cimplicity's trend module uses SQL calls to the historians to select data for display. After the trend is started, it reads only new data.

5.4.D - Interface for HMI Historical and Alarm Logs

Cimplicity's historian and alarm logging use SQL calls to the historians to log the data in Oracle. Separate event and alarm tables are kept in the database schema.

5.4.E - Table Structure

The table structure is 'long and narrow', usually having only point tag, timestamp, value, and engineering units.

5.4.F - Query Structure (Section to be completed)

SECTION 6 - COMMUNICATION STANDARDS

Section 6.0 - Introduction

The goal of a properly designed communications system is to carry the information sent on it in a quick, secure, error-free manner. To accomplish this in the Automation System, several types of communication are used including serial data highways, radio and leased line modems, local area networks on fiber and copper cabling, frame relay wide area network, and routed interconnections to other networks.

Section 6.1 - Control Network LAN Design

The Control Network uses fiber optic cabling from building to building or area to area due to distance limitations and for ground isolation. Other signals are run on the fiber as well, including video cameras and the Information Network. The fiber runs are patched in cabinets, generally in tunnels, which have no electronics in them (passive patch panels). Connecting a remote drop or run to a network switch cabinet is done by patching the correct fibers together in the panel.

6.1.A - Topology

The Control Network uses a series of network switches in a logical loop, broken at a location chosen by spanning tree protocol negotiation. If any one fiber segment or switch becomes unusable, the spanning tree break is closed and traffic continues via that route between the remaining members. At each switch, local devices are attached.

6.1.B - Monitoring / Management

Each device on the network is capable of reporting its status via SNMP protocol, and the switches are addressable by http protocol, having a small web server for configuration and status built in. The computers can to some degree be monitored by SNMP using a manufacturer-specific interface. The SNMP management capabilities have not yet been implemented, but are planned within the year.

Computer workstation management is performed by various scripts, operating system permissions and shells, and audit/log files. In ACS/S', redundant power supplies and RAID level 5 disk arrays are used to mitigate the effects of single component failures.

Section 6.2 - Control Network WAN Design

The control network WAN has been planned as a separate set of DS0 to DS1 speed lines using frame relay services provided by a LEC. It may also be implemented as 64K segments in the Information Network's DS1 frame relay network. This section will be amended when the WAN is implemented.

6.2.A - Topology

When implemented, the topology will probably be a fully webbed configuration between plants. EMSC may be served off of Southerly or may be served separately, depending on load projections.

6.2.B - Frame Relay Interface

When implemented, the interface will most likely be FRADs supplied by the LEC who provides the lines. If private cabling is used, we will use Cisco for consistency with other network equipment.

Section 6.3 - LAN / WAN Hardware

6.3.A - Switches

The switches isolate traffic between pairs of computers to a virtual network running at full wire speed. Computers are connected at 100Mb/s. PLCs will go no faster than 10Mb/s since they use AUI ports. The network switches have 24 10/100base T ports and two open bays in which port modules may be added. The switches may be managed by terminal, telnet, or http.

1. Standard: Cisco 2924M-XL-EN

6.3.B - Routers

Routers are used to connect from the Control Network to the Information Network. They are set to allow communication only between the Oracle database servers on the two networks. The switch performs network address translation. The ports run at 10/100Mb/s.

1. Standard: Cisco 2621

6.3.C - Media Converters and Transceivers

The cost of fiber cards for the switches, particularly single-mode cards, was considered excessive, so fiber to twisted pair media converters are used for all connections not in the immediate area/building. This includes switch-to-switch runs. The converters have very low latency, on the order of 4 to 8 bits worth of time delay.

For PLCs, an external transceiver is used, either AUI to fiber ST connection or AUI to RJ-45 if in the building with a network switch. All have at least link, receive, transmit and power lights.

1. Manufacturers:
 - a. Lancastr
 - b. Cabletron
 - c. Unicom

2. Model numbers: Media Converters are all Lancast Twister models with ST connectors:
 - a. 100M rack card, Single Mode – 7131-16-75
 - b. 10M rack card, Single Mode – 7111-16-75
 - c. 100M stand-alone, Single Mode – 2131-16-01
 - d. 10M standalone, Single Mode – 2111-16-01
 - e. 100M rack card, Multi Mode – 7131-15-75
 - f. 10M rack card, Multi Mode – 7111-15-75
 - g. 100M stand-alone, Multi Mode – 2131-15-01
 - h. 0M standalone, Multi Mode – 2111-15-01
 - i. Rack w/dual power supplies – 7500-17HS-2A
 - j. SNMP card for rack – 7501-M
3. Model numbers: Transceivers, AUI port to designated media.
 - a. Single Mode fiber – Cabletron FOT-3
 - b. Multi Mode fiber – Cabletron FOT-24
 - c. RJ45 (twisted Pair) – Unicom ETP-20028T-S or equal from Cabletron or Lancast

Section 6.4 - TCP / IP Protocol

The TCP/IP protocol is exclusively used for communications between PLCs, computers, and other network devices. A numbering and naming system has been devised and implemented in the plants.

6.4.A - Numbering system and ranges

The control network uses a private address range, 192.168.x.x. The plants use a 2-bit submask in the third octet, 255.255.252.0, yielding over 700 addresses per subnet. The subnet scheme also allows for devices to be changed to a 1-bit subnet and see all traffic at all plants when a wide area network is installed. Ranges are as shown in Appendix ____, which includes a current address list.

It must be noted that despite Allen-Bradley literature leading the user to believe PLCs can be subnetted freely, the only subnet they will recognize is a fourth octet subnet. Because of this, all ACS/S (HMI servers) must use the same third octet number as the PLCs. ACS (view stations) can use any number in the subnet range. This limits the total number of PLCs and ACS/S' to 254. We currently use less than 50% of the addresses and do not anticipate running out.

Section 6.5 - Pump Station Communication

The pump stations use leased lines and leased line modems for communication between Allen-Bradley PLCs. The PLC at the plant is polled to obtain the statuses and values of points at the pump station. **Note that cellular communications are being designed for new and retrofit projects. Contact the District Manager of Process Control and Automation for the latest standards.**

6.5.A - Modem

Two different types of modem are used, a 2-wire leased line and a 4-wire leased line modem, both running at 33.6Kbaud or as negotiated when line conditions change.

1. Standards:
 - a. 4-wire leased line –
 - b. 2-wire leased line –

6.5.B - Dedicated Leased Lines

Dedicated leased lines are provided by the LEC, AT&T. Records for the leased lines are kept by the EIS department.

Section 6.6 - Remote Collection System Site Modem Communication

The remote collection system sites are currently managed by a combination of Modicon PLC software, Factorylink OS/2 software, DB/2 database, and custom software. Leased line modems are used. The system is slated for upgrade in the next 2 years. Standards may be different because of the need to continue operation during communications failures common with remote sites such as these.

See the District Manager of Process Control and Automation for the latest configuration.

Section 6.7 - Remote Collection System Site Radio Communication

The remote collection system sites are currently managed by a combination of Modicon PLC software, Factorylink OS/2 software, DB/2 database, and custom software. The radio communication uses 924MHz MDS 9600 baud modems and currently has a 5-minute poll cycle to allow for incomplete transmissions and other communications errors. The system is slated for upgrade in the next 2 years. Standards may be different because of the need to continue operation during communications failures common with remote sites such as these.

See the District Manager of Process Control and Automation for the latest configuration.

Section 7 - Electrical Standards

Section - 7.0 - See NEORSD Engineering and Construction Department

Electrical standards have been removed from the NEORSD Automation Standards and Conventions Manual. They are now being maintained separately.

Contact the NEORSD Engineering and Construction department for the latest Electrical Standards.

Section 8 - CCTV System

Section - 8.0 - Introduction

Section – 8.1 - CCTV Equipment

This section provides the detailed requirements for the CCTV monitoring system.

The CCTV monitoring system details include the following:

- A. Cameras
- B. Camera Housing
- C. Pan and Tilt Drive
- D. Camera Mounting Brackets
- E. Receiver
- F. Surge Protection
- G. Cables
- H. Video Camera Transceiver Links
- I. System Controller
- J. Monitors
- K. Digital Multiplexers
- L. VCR

Detailed Specifications

8.1.A - Color Cameras:

1. Cameras for the CCTV Monitoring System shall be digitally encoded to enable a variety of picture enhancements. The digital cameras shall provide increased lens sensitivity, aperture correction, electronic light control (equivalent to shutter speed of 1/60 sec. and 1/15,700 sec.), and back lighted compensation for crisp, sharp pictures. The cameras shall be equipped with a zoom auto 2 inch iris lens for wide angle viewing, with a maximum aperture ratio of 1:0.75 and a filter size of M40.5 mm. Each camera shall be provided with pan/tilt/zoom features for motion control.
2. All cameras shall permit program setup of camera ID, light control, backlight compensation, shutter speed, and automatic gain control. All programmed information shall be retained in each camera's non-volatile memory. A setup disable function shall prevent accidental and unauthorized operation of the camera system. The lenses shall be one (1) inch nominal motorized zoom.
3. The Camera pick-up device shall be 512(H) x 492(H) pixels, minimum, Interline Transfer CCD.
4. The cameras shall consist of the following features
 - a. Scanning Area: Scanning Area shall be 4.8(H) x 3.6(V) mm.
 - b. Scanning System: 525 lines/60 fields/30 frames,
Horizontal 15.734 kHz,
Vertical 59.94kHz.
 - c. Video Output: 1.0 V p-p, composite, 75 Ohms, BNC Connector
 - d. Minimum Illumination: 0.11 fc at f/1.2

- e. Detail: User selectable, Sharp or Soft
- f. Temperature: -10 deg C to 50 deg C
- g. Humidity: 0 to 90 % RH, Non-condensing
- h. Power Requirements: 0.2 amps at 120 VAC, 60 Hz, single phase.
- i. Mounting: Suitable for outdoor or Indoor mounting.
- 5. Product and Manufacturer: Provide one of the following:
 - a. Panasonic
 - b. Or equal

8.1.B - Camera Housing:

1. Camera housings shall be rated for indoor, environmental and explosion-proof applications, as required.
2. For indoor applications, each camera shall be enclosed in an extruded aluminum housing. Housing shall include a removable front cap to access lens focus adjustment and servicing, and a rear cap for access to camera sled and installation of power and video cables. The housing shall be compatible for use with ceiling, column, pedestal, pipe, or wall mount brackets.
3. For environmental applications each camera shall be enclosed in a weatherproof extruded aluminum housing with thermostat controlled, factory installed heater and blower, both at 24 vac. The housing shall include a side hinge to access lens focus adjustment and servicing and shall be suitable for use with a sun shield. The housing shall be compatible for use with ceiling, column, parapet, pedestal, pipe, pole, or wall mount brackets.
4. Explosion-proof housings shall be provided for cameras located in hazardous locations as designated in the camera list. The housings shall comply with the requirements for Class 1, Division 1, Group D, Hazardous locations as defined by the National Electric Code, the requirements of Underwriters Laboratories Standard, U.L. 1203, and all other safety codes pertaining thereto.
5. The camera housings shall consist of the following features:
 - a. Extruded aluminum body.
 - b. Camera access through rear cap.
 - c. Unit base bolt hole pattern to be compatible with remote positioning device provided.
 - d. Plastic end caps
 - e. Sunshield for outdoor locations
6. Product and Manufacturer: Provide one of the following:
 - a. PELCO
 - b. Or equal.

8.1.C - Pan and Tilt Drive:

1. All cameras shall be provided with remote positioning devices consisting of pan and tilt drives.
2. Pan and tilt drives for environmental cameras shall be of weatherproof, corrosion resistant construction.
3. Pan and tilt drives for cameras in hazardous locations shall be enclosed in explosion-proof housings. The housings shall comply with the requirements for Class 1,

- Division 1, Group D, Hazardous locations as defined by the National Electric Code, the requirements of Underwriters Laboratories Standard, U.L. 1203, and all other safety codes pertaining thereto.
4. As a minimum, the pan and tilt drives shall consist of the following features:
 - a. Panning Angle: 10 - 340 degrees (Adjustable).
 - b. Tilting Angle: 45 degrees up, 45 degrees down from center position for indoor cameras.
15 degrees up, 60 degrees down from center position for outdoor cameras.
 - c. Panning: Automatic or Manual (Selectable)
 - d. Panning speed: 7 degrees/sec.
 - e. Tilting Speed: 4 - 45 degrees/sec.
 - f. Operating Temp: -4 deg F to 122 deg F.
 - g. Power Supply: 24 VAC (Environmental).
120 VAC (Explosion-proof)
 - h. Capable of inverted operation.
 - i. Externally adjustable limit switches.
 - j. Pan and tilt drives with internal stops.
 - k. Tilt motor thermal protection switch.
 - l. Pan motor impedance protection.
 5. Product and Manufacturer: Provide one of the following:
 - a. PELCO
 - b. Or equal.

8.1.D - Camera Mounting Brackets:

1. All mounting brackets shall be of corrosion-resistant construction and shall be load rated to support camera, housing and pan and tilt drive components and accessories specified herein. Mounting heads shall be adjustable.
2. Mounting shall be suitable for ceiling, column, parapet, pedestal, pipe, pole, or wall mounting, as indicated in the camera list and mounting details provided in this specification.

8.1.E - Receiver:

1. Receivers shall be provided to relay control signals to the camera pan/tilt units, cameras and accessories specified herein. All mounting hardware shall be provided for complete installation.
2. For environmental cameras, receivers shall be installed in weatherproof enclosures. For cameras located in hazardous areas, receivers shall be enclosed in explosion-proof housings. The housings shall comply with the requirements for Class 1, Group D, Hazardous locations as defined by the National Electric Code, the requirements of Underwriters Laboratories Standard, U.L. 1203, and all other safety codes pertaining thereto.
3. Product and Manufacturer: Provide one of the following:
 - a. American Dynamic.
 - b. Or equal.

8.1.F - Surge Protection:

1. Each camera shall be protected with lightning arrestor at each end of the cable, at the camera site and the head end equipment at the control console. The connections to the surge protection devices shall be made with BNC connectors.
2. Product and Manufacturer: Provide one of the following:
 - a. Atlantic Scientific.
 - b. Or equal.

8.1.G - Cables:

1. Provide coaxial cables with connectors at both ends for interconnection of supplied equipment at the control console.

8.1.H - Video Camera Transceiver Links:

1. The cameras shall be connected to the central monitoring equipment via Fiber Optic Links for transmission of baseband video signals over long distances, without repeaters and no user adjustment. The transmitted signal shall be immune to EMI and RFI interferences. The transceivers shall transmit video and provide bi-directional control for pan/tilt/zoom functions.
2. The transceiver links shall consist of the following:
 - a. Video Bandwidth: 6.5 MHz
 - b. Optical Loss: up to 13 dB, maximum over the entire range.
 - c. Wavelength: 1300 nm.
 - d. Transmitter Power: -15.5 dBm.
 - e. Receiver Sensitivity: -28.5 dBm.
 - f. Input level: 1.0 V p-p
 - g. Input Impedance: 75 Ohms.
 - h. SNR: > 50 dB
 - i. Differential Phase: 2 degree maximum
 - j. Differential gain: 3% maximum.
 - k. Connectors: BNC
 - l. Power Supply: 320 mA at 12 to 18 VDC for both transmitter receivers.
 - m. Fiber Cable: 62.5/125 um fiber at 25 degree
3. Product and Manufacturer: Provide one of the following:
 - a. Litton Poly Scientific.
 - b. Or equal.

8.1.I - System Controller:

1. The microprocessor based multifunction system controller shall be used for setup , camera control, and video routing. Two (2) lines of LCD display, four (4) Function keys, numeric keypad, joystick, camera key and monitor key, and cursor keys shall be provided.
2. Sequence function shall include go, stop, back sequence, forward sequence, increment and decrement sequence. Lens functions shall include iris open, close,

- focus far, near, zoom telephoto and wide angle. Joystick functions shall include tilt up and down, pan right and left and preset.
3. The controller shall communicate with the multiplexer via RS-485 port at 9600 baud, minimum.
 4. The system controller shall contain the following minimum features:
 - a. Menu driven program for camera, video routing setup for up to 128 cameras and 16 monitors.
 - b. Permit programming of group of cameras for display on group of monitors.
 - c. Password protection against use by unauthorized personnel.
 - d. LED alarm indication blinking to identify an alarm conditions exists.
 - e. LCD display of date, time, camera number, alarm status, and 16 character user programmable titles for immediate location identification.
 - f. The keyboard shall be capable of activating and controlling all control functions described above for each camera, with a joystick and Function Keys.
 - g. All custom configuration programs, camera settings, I/O tables, etc. shall be made available to the NEORSD.
 - h. The Controller shall interface with a 80 column parallel printer for hard copy printouts of alarms. Each alarm shall be date and time stamped.
 5. Product and Manufacturer: Provide one of the following:
 - a. Panasonic.
 - b. Or equal.

8.1.J - Monitors:

1. The color video monitor shall be 14-inch diagonal screen monitor with horizontal resolution of at least 700 lines center. The monitors shall feature manual controls for adjustment of tint, sub-tint, brightness, sub-brightness, contrast, sub-contrast, picture and audio level. The monitors shall have 2 BNC video outputs and 2 BNC video inputs, S-video input and output connectors The monitors shall be UL listed.
2. The monitors shall consist of the following features:
 - a. Video Input: Two (2) 1.0 V p-p, 75 Ohm, composite via a BNC connector.
 - b. Video output: Two (2) 1.0 V p-p, 75 Ohm, composite via a BNC connector.
 - c. S-Video Input: One (1) Y: 1.0 V p-p, 75 Ohm, C: 0.286 V p-p 75 Ohm, via mini DIN 4-pin connector.
 - d. S-Video Output: One (1) Y: 1.0 V p-p, 75 Ohm, C: 0.286 V p-p 75 Ohm, via mini DIN 4-pin connector.
 - e. Audio Input: Two (2) -8 dB/Hi-Z via RCA connector
 - f. Audio Output: Two (2) RCA connectors
 - g. Power Supply: 120 VAC, 60 Hz, single phase.
3. Product and Manufacturer: Provide one of the following:
 - a. Panasonic.
 - b. Or equal.

8.1.K - Digital Multiplexers:

1. The digital multiplexer shall be high performance, flexible and shall control up to 16 video input channels and permit multiplexed field recording of 16 cameras with a single VCR. The unit shall permit full screen monitoring of 4,7,9,10,13 and 16 multi screen monitoring modes.
2. The multiplexer shall include front panel and remotely controlled VTR functions including record, play, reverse play, rewind, forward, pause, stop and recording time mode. Up to 4 multiplexers may be cascaded to record up to 64 cameras inputs. The single spot controller shall display video images of any camera connected to the system via system controller. The unit shall provide a digital display on the monitor and also recording of year, month, day, hour, minute and second as well as alphanumeric camera location ID up to 8 characters, on tape.
3. The multiplexer shall feature a built-in programmable switcher with dwell time and camera order programming. It shall automatically switch camera images to enable sequential spot monitoring and simultaneous field recording. All multiplexers provided under this Contract shall be connected via RG59/U coaxial cable using BNC connectors.
4. The multiplexer shall allow for recorded images to be played back in full screen, or in 4, 9 or 16 multi screen display mode. It shall also feature multi spot playback mode which shall combine 3 multiplexer functions, playback, record, and live multi-screen monitoring. In this mode, the unit shall feature playback from video tape recorder #1, displayed in the upper left corner display of 4, 7, 10, 13 multi screen modes. In addition, the duplex multiplexer shall feature live viewing of cameras on remaining multi screen views. Freeze mode shall be available for VCR playback
5. The multiplexer shall provide access to all camera control, setup, alarm functions, including preset sort and sequence, Super Dynamic activation, digital motion mask set, electronic sensitivity up and backlight compensation set-up.
6. The controls for pan/tilt/zoom cameras shall be accessible via system controller. These functions shall include direct access of preset position, zoom near or far, focus near or far, iris open or close, pan right or left, tilt up or down. The multiplexer shall also provide 1/60 sec refresh rate for 4 cameras at once. Loss of video detection for any channel shall be alarmed.
7. In addition to monitor displays and alarms, the tape recording shall be date and time stamped for all channels.
8. Cameras setup and control functions shall be accessible for cameras 5-8, 9-12, and 13-16, which shall provide cable compensation of up to 3000 feet with no loss of video or control signal degradation.
9. The following features shall be provided as a minim
 - a. Resolution: 720 x 486 pixels, minimum.
 - b. Frame memory: Quantizing 8-bit.
 - c. Internal Sync: 2:1 Interlace, Horizontal 15.734 kHz, Vertical 9.94 kHz.
 - d. Input Signal: Sixteen (16) 1 V p-p / 75 Ohm (BNC) connector with loop through outputs, and automatic termination.
 - e. Spot Input: 1 V p-p / 75 Ohm (BNC) x 1

- f. Time Adjust
 - Input: 1 D-SUB 37 pin Connector
- g. Output Signal:
 - Spot Input: 1 V p-p / 75 Ohm (BNC) x 1.
 - Multi screen Output: 1 V p-p /75 Ohm (BNC)
x 1, S.Video x 1.
 - Recording Output: 1 V p-p/75 Ohm
(BNC) x 1, S.Video x 1.
- h. Power Supply: 120 VAC, 60 Hz, single phase.
- 10. Product and Manufacturer: Provide one of the following:
 - a. Panasonic.
 - b. Or equal.

8.1.L - Video Cassette Recorder (VCR):

1. The VCRs supplied under this contract shall be industrial grade recorder and not a modified consumer unit. The recorder shall be VHS compatible. The VCRs shall have two (2) audio channels and flying erase heads for cleaning transitions. The recorders shall include both SP and SLP record mode and SP, LP, and SLP play back modes. All connections shall be BNC or RCA connectors. Video image processor shall multiplex up to 16 video signals and output to a VCR for recording on one tape simultaneously without synchronization between inputs. Each camera recorded on the VCR tape shall be numbered and shall be played back as a single display or quad display by selection of any channel on the video image processor.
2. A freeze switch shall allow study of a single picture. The unit shall be capable of 19 inch rack mounting.
3. The following features shall be provided as a minimum:
 - a. Modulation System: Luminance, FM azimuth recording.
 - b. Tape format: VHS tape
 - c. Tape Speed: 33.35 mm/sec
 - d. Recording/ playback: 12/8/24 hours in linear slow Time Mode
and 24 / 48 / 72 / 84 / 120 / 180 /
40 / 480 hours and 1-shot in time lapse
mode.
 - e. FF/Rewind speed: 3 minutes, approx.
 - f. Video IN (BNC) 1.0 V p-p, 75 ohm unbalanced
 - g. Video Out (BNC) 1.0 V p-p, 75 ohm unbalanced
 - h. SNR: VHS 46 dB
 - i. Horizontal Resolution: VHS 240 lines in color
 - j. Audio IN Phono -10 dBV, 47 ohms, unbalanced
 - k. MIC In: -60 dBV, 600 ohms to 4.7 kOhms,
unbalanced
 - l. Camera Switch Output
 - Timing 1: 5V/0V, Pulse width: 4.7 msec
 - Timing 2: 12V/0V, Pulse width:16.7 msec
 - m. Power Supply: 120 VAC, 60 Hz, single phase.
4. Product and Manufacturer: Provide one of the following:
 - a. Panasonic.

- b. Or equal.

Reference Standards

1. American National Standards Institute (ANSI).
2. Factory Mutual (FM).
3. Institute of Electrical and Electronic Engineers (IEEE).
4. National Electric Code (NEC).
5. National Electrical Manufacturers Association (NEMA).
6. Underwriters' Laboratories (UL).

Installation Details - this section does not contain all installation details for the equipment/ system shown, only those that are required by the NEORSD. These details may exceed those required by the equipment manufacturer or local codes.

1. Install in conformance with the requirements of NEC.
2. Install the video cameras at the locations shown on the drawings and in accordance with the manufacturer's recommendations.
3. CONTRACTOR shall ensure that adequate strain relief is provided in the installation of cameras to prevent premature damage to cables caused by continual flexing in pan/tilt applications.

SECTION 9 - Instrumentation, System Integration, and Testing

Section 9.0 - Introduction

This section reviews the standards and conventions for instrumentation, panels, system integrators, and testing.

Section 9.1 - Instrument and Panel Tagging

Instrument and control valve tags shall be the NEORSD site designator followed by the NEORSD area number/location followed by the ISA (International Society of Automation) designation and the instrument loop number. All alpha characters are upper case. Components of the tag are separated by dashes.

Wastewater Treatment Plant Instrument and Control Valve Tag Format:

S-AA-Z...Z-nnnn

Where:

“S” is the site designator (upper case). “E” for Easterly. “W” for Westerly. “S” for Southerly. [Collection System sites are listed in Part II, Section 1.5, Paragraph I - Site Designator.]

“AA” is a two digit numeric code designating the process area in a treatment plant (see

tables below for treatment plant process area codes)

“Z...Z” is the ISA alpha character designation for the instrument or control valve function (follows the ISA standard “ISA-5.1” entitled “Instrumentation Symbols and Identification”). It is typically between 2 and 4 characters long, upper case.

“nnnn” is the same four-digit loop number identifier to be used in the point tag as described in Section 1.5 - Point Tag Naming Convention.

For example, at the Southerly Wastewater Treatment Center (WWTC), a flow indicating transmitter in the Second Stage Aeration Area would have the tag:

S-22-FIT-nnnn

A high level switch in the Screening Area at the Easterly WWTP would have the tag:

E-05-LSH-nnnn

A level control valve at the Westerly WWTP Disinfection Area would have the tag:

W-35-LCV-nnnn

Note to specifier: P&IDs typically do not show the entire instrument and valve tag as long as there is a note on the P&ID that all instrument and valve tags are preceded by the site designation and area number, for example, “S-22”. The instrument and valve “bubble” on the P&ID would contain, for example, “FIT-1005”.

Collection System Instrument and Control Valve Tag Format:

S-LL-Z..Z-nnnn

Where:

“S” is the Collection System site type designator (upper case alpha). “P” is used for remote pump stations and “A” is for automated regulator sites. Other Collection System site abbreviations are listed in Part II, Section 1.5, Paragraph I – Site Designator.

“LL” is a two character upper case alpha code designating the location in the Collection System. See Part II, Section 1.5, Paragraph II – Collection System and Remote Sites for the codes.

“Z...Z” is the ISA alpha character designation for the instrument’s function (follows the ISA standard “ISA-5.1” entitled “Instrumentation Symbols and Identification”). It is typically between 2 and 4 characters long, upper case.

“nnnn” is the same four-digit loop number identifier to be used in the point tag as

described in Section 1.5 - Point Tag Naming Convention.

A level indicating transmitter at the Division Avenue remote pump station would be:

P-DA-LIT-nnnn (where “P” is for remote pump station, “DA” is for the Division Avenue Pump Station, “LIT” is for level indicating transmitter, and “nnnn” is for the loop number. [Note that there are no process area numbers used in the Collection System]).

Note to specifier: P&IDs typically do not show the entire instrument and valve tag as long as there is a note on the P&ID that all instrument and valve tags are preceded by the site type designation and location, for example, “P-DA”. The instrument and valve “bubble” on the P&ID would contain, for example, “LIT-1006”.

Panel tags shall follow the formats listed below. Examples of panels are PLC control panel (PLC), local control panel (LCO), local control station (LCS), motor control center (MCC), variable frequency drive (VFD) panel, area control panel (ACP), operator interface terminal (OIT), etc.

Wastewater Treatment Plant Panel Tag Format:

S-AA-P..P-N..N

Where:

“S” is the site designator (upper case alpha). “E” is for Easterly. “W” for Westerly. “S” for Southerly.

“AA” is a two digit numeric code designating the process area in a treatment plant See tables below for numeric codes for plant areas)

“P. .P” is the abbreviation (upper case alpha characters) for the type of panel or device. Examples are: PLC, RIO, LCP, LCS, MCC, VFD, OIT, HMI. See panel abbreviation list in Part IV, Section 7.1.

“N..N” is the identifier for the PLC, OIT, MCC, etc. Examples are: CN, CS1, CS2, COL1, COL8A, RSP1, BL1.

Sample treatment plant panel tags:

S-19-PLC-CS, S-20-PLC-CN, S-19-RIO-CS1, S-19-OIT-CS1, S-19-OIT-CS2, S-20-PLC-BL1, S-20-PLC-BL2.

Collection System Panel Tag Format:

S-L.L-P..P-N..N

Where:

“S” is the Collection System site type designator (upper case). “P” is used for remote pump stations and “A” is for automated regulator sites. Other Collection System site abbreviations are listed in Part II, Section 1.5, Paragraph I – Site Designator.

“LL” is a two or three character upper case alpha code designating the location in the Collection System. One example is “DA” for the Division Avenue pump station. See Part II, Section 1.5, Paragraph II – Collection System and Remote Sites for the codes

“P. .P” is the abbreviation (upper case alpha characters) for the type of panel or device. Examples are: PLC, RIO, LCP, LCS, MCC, VFD, OIT, HMI. See panel abbreviation list in Part IV, Section 7.1.

“N..N” is the identifier for the PLC, OIT, MCC, etc.

Below are process area codes (“AA” in instrument, control valve, and panel tag format) for the wastewater treatment plants: the Westerly Wastewater Treatment Center, the Easterly Wastewater Treatment Plant and the Southerly Wastewater Treatment Center.

The process area codes below were updated in December 2012. Changes to the codes and descriptions after this date and before the next revision of the Plant Automation Standards Manual can be found in the District’s Oracle Work and Asset Management system (WAM-SPL).

9.1.A - Westerly Wastewater Treatment Center

<u>Westerly Wastewater Treatment Center</u>	
<i>Area Description</i>	<i>Code</i>
Administration Building	10
Switchgear Building	11
Screen Building	12
CSOTF Dewatering Building	13
Pipe Gallery Area (Plant-wide)	14
Primary Settling Tanks Area	15
CSOTF Degritting Building	16
Solids Handling Building	20
Inactive (Formerly Lube Storage Building)	21
Gravity Thickener Tank Area	25
Chemical Handling Building	30
Disinfection Area	35

Maintenance Center	40
Emergency Backup Generators	70
Hypo / Bisulfite Building	75
CSOTF Settling Basins Area	80
Final Settling Tanks Area	81
Trickling Filters Area	82
Solids Contact Tanks Area	83
Primary Effluent Pump Station	84
Blower Room (Solids Contact Area)	85
Return Secondary Sludge Building	86
RSS Pumps / Odor Control Building	87
MCC Room TF / SC Complex	88
Substation 9 TF / SC Complex	89
Locker / Storage Building	90
Inactive (Formerly Stockroom Building)	91
Machine Shop Area	92
Fuel Oil Storage Area	93
Gas Meter House Building	94
Security Building	96
Inactive (Formerly Permanent Office Trailers)	97
General Plant Area	99

9.1.B - Easterly Wastewater Treatment Center

<u>Easterly Wastewater Treatment Plant</u>	
<i>Area Description</i>	<i>Code</i>
Inactive (Retired)	01
Inactive (Retired)	02
Screening Area	05
Screening Conveyance Area	06
Detritus Tanks Area	07
Grit Dewatering Area	08
Collinwood Pump Area	09
Headworks Main Control Area	10
Headworks Building – Lower Level	11
Headworks Building – Upper Level	14
Engineer Building / Lube Shop	15
Pre-Aeration Tanks Area - <i>demolished</i>	18
Aerated Grit Facility	20
Grease Flock Area	21
Grease Reactor Area	22
Chemical Storage and Feed Facility	23
Service Building West Gallery	24
Service Building Central Gallery	25
Service Building East Gallery	26
Service Building Central Gallery - Basement Area	27
Primary Settling Tanks Area	28
Primary Main Control Room Area	29
Southerly Pump Building Complex	30
Service Building Area	31
Lake Water Pump Building	32
Lubrication Storage Building (Rev. F)	33
Wet Weather Pump Station Area	34
Aeration Tanks Area	38
Pump Building West Gallery	39
Pump Building East Gallery	40
Pump Building Control Area	41
Pump Building 2nd Level Central Area	42
Pump Building Basement Area	43
Pump Building Area	45
Disinfection - Bypass Building	46
Final Settling Tanks Area	48
1st Floor Blower Room Area	50
2nd Floor Blower Building Area	51
Blower Building Area	54
Emergency Backup Generators	57

Screw Pump Area	67
Easterly Wastewater Treatment Plant (continued)	
<i>Area Description</i>	<i>Code</i>
Effluent - Main Control Office	68
Bisulfite Pump and Storage Area	69
Inactive (Retired)	70
Effluent - 2nd Level Basement Area	71
Effluent - 3rd Level Basement Area	72
Chlorine Contact Tanks Area	73
Effluent - Monitoring Room Area	74
Effluent Building Area	78
Administration Building	80
Tunnel – Administration to Blower Building Area	84
Tunnel - Administration to Service Tunnel Area	85
Tunnel – Blower to Pump Building Area	86
Tunnel - Pump to Service Building Area	87
Stockroom Area	91
Machine Shop Area	92
Security Building Area	96
General Plant Area	99

9.1.C - Southerly Wastewater Treatment Center

<u>Southerly Wastewater Treatment Center</u>	
<i>Area Description</i>	<i>Code</i>
Gas Well	00
Screen & Grit Building	01
Access Building #1	02
Access Building #2	03
Access Building #3	04
Access Building #4	05
Access Building #5	06
Primary Settling #1-10 Area	07
Primary Setting #11-18 Area	10
Chemical Handling Building	11
First Stage Aeration "A" Area (Not In Service)	12
First Stage Aeration "B" Area (Not In Service)	13
First Stage Aeration "C" Area	14
First Stage Blower Building	15
First Stage Settling "A" Area (Not In Service)	17
First Stage Settling "B" Area (Not In Service)	18
First Stage Settling "C" Area	19
Return Sludge Pump Station "C" Gallery	20
Second Stage Lift Station Building	21
Second Stage Aeration Area	22
Second Stage Blower Building	23
Second Stage Settling Area	24
Second Stage Return Sludge Pumping Station	26
Effluent Filter & Administration Building	30
Operators Locker Room	33
Disinfection Building	34
Cyclone Degritting Building	35
Gravity Thickeners Building	36
Excess Activated Sludge (EAS) Thickening Building	37
Sludge Storage Tanks Area	38
VCU & Thermal Conditioning	39
T.C. Sludge Thickeners Building	40
T.C.S.T. Odor Control Building	41
Sludge Dewatering Building	42
Dewatering VCU Building	43
Incineration Building	44
Incineration - Auxiliary Building	45
Ash Lagoon Area	46
Future Fluid Bed Incineration (FBI)	47

Skimmings Building #1	48
Southerly Wastewater Treatment Center (continued)	
Area Description	Code
Skimmings Building #2	50
Skimmings Decant & Storage	51
Steam Generation Building	52
Odor Control B Building	53
Waste Liquor Handling Building	54
Odor Control A Building	55
Digester A (Not In Service)	56
Future Biosolids Handling (FBI project)	57
CVI Lift Station Building	58
Stormwater Pump Station #1	60
Stormwater Pump Station #2	61
Stormwater Pump Station #3	62
River Gates Area	63
Future Green Energy Building (FBI project)	67
Emergency Backup Generators & Switchgear Bldg	70
Main Substation	73
Equipment Storage Building	75
Old Pump House	86
Easterly Sludge Line Vault Area	87
Labor Storage Building	88
Building Maintenance / Scour Bldg	89
Inactive (Retired)	91
Water Meter House #1 & #2	93
Gas Meter House	94
Maintenance Building	95
Security Building	96
Resident Engineering Building	97
General Plant Area	99

Section 9.2 - System Integrator

9.2.A - Summary

All equipment, components, and materials required for the control system, network, and other items within scope shall be furnished by the System Integrator who shall assume the responsibility for suitability and performance of all items. New panels and the equipment inside those panels shall be furnished and mounted by the System Integrator. All wiring within the panel shall be provided by the System Integrator. Equipment for existing panels shall be provided and installed by the System Integrator. Installation of the panels and mounting hardware and the procurement and installation of all interconnecting wire, cable, conduit, and cable tray (as required) shall be the responsibility of the CONTRACTOR. The CONTRACTOR shall also provide and install all power and other services required by the panels.

It shall be the responsibility of the CONTRACTOR to insure that the System Integrator is performing required duties and providing required drawings, documentation, and data.

9.2.B - System Integrator's Qualifications

Shall have a demonstrated record of prompt positive response to field failures.

Shall have a record of prompt deliveries in accordance with contract obligations required for previous projects

Shall have a demonstrated experience record of successful installations for a minimum of three years.

Shall be a member in good standing of the Control System Integrators Association (CSIA) or endorsed by other industry organizations. Certified members of CSIA preferred. System Integrator must provide proof of successful completion of previous projects and shall be subject to one or more audits, at the OWNER's discretion, before, during, or after the project. System Integrator shall supply examples of and references from at least three similar projects involving DeviceNet within the past five years that they have successfully completed.

For all Rockwell and Rockwell partner equipment, the System Integrator shall be a Rockwell listed and certified Solution Provider. Secondary preference shall be given to Rockwell listed System Integrators.

System Integrator shall have an office or location staffed with competent System Integrators that shall be used for the Work within 250 miles of the job site.

System Integrator shall have ISO 9001 certification. If System Integrator does not have this certification, then they shall be subject to a quality management audit by the District or the District's representative.

The System Integrator shall supply detailed resumes and work experience for the staff that shall be working on the project. This requirement shall apply both to office staff and field staff of the

System Integrator. Because of the highly technical and skilled nature of the work, the District shall retain the right of approval and removal of all System Integrator staff.

9.2.C - System Integration Responsibilities

CONTRACTOR shall retain the System Integrator to assume the responsibilities specified below. However, delegating these specified responsibilities to the System Integrator shall not relieve the CONTRACTOR of the ultimate responsibility for completion of the work specified in the Contract.

The Integrator shall:

- Install and wire the system
- Verify signal paths for all points connected to the control system under the Contract, whether new or existing
- Verify that termination points have been properly wired
- Develop detailed documentation that covers system configuration, control logic programming, HMI system programming, loop checks, testing, troubleshooting, commissioning of the instrumentation / control system in accordance with the Contract Documents, network and system interconnection drawings, and verification of meeting all applicable codes, standards, and regulations
- Provide all specified process control system related training.

The Integrator shall also be responsible for:

- Integration of system workshops, installation, testing, and commissioning activities into the overall project schedule
- Preparation, organization, binding, electronic copying, submission, and correction of all instrumentation and control system submittals

Where requested by the District or its representative, the Integrator shall submit documents pertaining to standards, engineering practices and recommendations, and physical systems and equipment that support:

- The validity of analytical/mathematical expressions that will be programmed into the process control and automation system.
- Development of written testing and verification procedures for every aspect of system performance.
- Installation, integration, and configuration of all software components and development of custom software, as required.
- Integration and interfacing of the instrumentation and control system hardware, software, licenses.

9.2.D - System Integrator's Project Personnel

CONTRACTOR shall require the System Integrator to provide a Field Engineer with the following responsibilities.

Provide advice and technical consultation concerning installation techniques and procedures for equipment furnished. The Field Engineer shall be on-site during the installation phase as required.

Installed system integration, customization, checkout, calibration, adjustment, and startup

Provide maintenance services during the field test.

Resolving problems encountered during initial startup and testing of all instrumentation and control equipment.

The Field Engineer shall have a minimum of five years experience in systems engineering and startup and shall have a thorough working knowledge of the hardware and software supplied for the instrumentation and control system.

9.2.E - Factory Acceptance Testing

If any type of process controls are to be provided, or expansion or modifications to the existing process control system are required to accomplish the objectives of a project, the Contractor must be required to perform, a factory acceptance test (FAT). The intent of the FAT is to demonstrate that the control panels, processors, controller(s), I/O, and HMI and OIT hardware and software and all other system components and software are demonstrated and verified for conformity with the contract requirements, approved submittals, and workshop discussions. The most recent version of the Component Settings Record (See Section 9.2S) shall be available and updated as necessary throughout the FAT. Operation of field devices shall be simulated either with hardware (switches, lights, potentiometers, etc.) or software as approved by the District. Software simulation routines that reside in the program of the equipment being tested shall be implemented in a manner that makes the routines easily identifiable and completely removable from the program prior to the site commissioning without affecting the MCS functionality of the program. The factory acceptance test shall demonstrate the following:

- Responses to all inputs
- Operation of all outputs with a dummy load
- Loop operation
- Control sequences
- Software and hardware Interlock operation
- Functionality of all communication links, including Ethernet, Fieldbus, DeviceNet, ControlNet, Data Highway, and similar communications
- Network communications
- HMI and OIT screens, displays, and alarms

- Operator control functions
- Physical, password, and information security measures
- Historized data

During the performance of the FAT, all HMI and OIT graphical screens shall be verified for completeness, functionality, and responsiveness. Also, all I/O shall be verified for proper linking to HMI and OIT graphical screen objects/symbols, alarm and event logs, and recording in the Historian. This shall be documented on I/O Checkout certification sheets that are described in Part II, Section 9.2R. Test all PLC I/O module channels using physical/hardwired connected test equipment that generates the signal type and span appropriate for each configured I/O module channel. Test all networked I/O using the actual networked equipment using physical/hardwired connected test equipment that generates the signal type and span appropriate for the configured networked equipment. Use of simulated I/O in the FAT shall be minimized and be allowed only with concurrence of the District.

Revisions to the PLC, OIT, and HMI software programming, from the start to the conclusion of the FAT, shall be continuously tracked using the Rockwell Software FactoryTalk AssetCentre application. Backup copies of all programs shall be made at the conclusion of the FAT.

Control panels that incorporate only hardwired control circuits shall undergo shop testing at the panel building facility, similar to a FAT, to demonstrate and verify proper functionality of the control panel.

The Contractor shall be required to provide the following documentation pertaining to the FAT:

- FAT Plan that describes the logistics and administrative aspects of the FAT
- List of all project deliverable panels, and control system equipment that will be demonstrated in the FAT
- List of all ancillary test equipment/apparatus used in the FAT
- Project documentation associated with the project deliverables
- FAT test procedures that precisely describe the features and functionalities to be demonstrated and the activities used to prosecute the demonstration
- FAT test records documenting and attesting to the FAT results.

9.2.F - System Checkout, Startup, and Commissioning Responsibilities

CONTRACTOR shall be responsible for providing all labor, materials, equipment, and incidentals necessary to perform and coordinate the checkout, startup, field testing, and commissioning of the instrumentation and control system.

CONTRACTOR shall retain the services of the System Integrator to supervise and/or perform checkout and startup of all system components. As part of these services, the System Integrator shall include for those equipment items not manufactured by him the services of an authorized manufacturer's representative to check the equipment installation and place the equipment in operation. The manufacturer's representative shall be thoroughly knowledgeable about the installation, operation, and maintenance of the equipment.

The Contractor shall supply the District with all information required including, as the District or its representative may request, references to engineering standards, engineering practices, and recommendations, and physical systems and equipment that validate analytical/mathematical expressions programmed into the process control system for the District to configure or program equipment or control systems under the District's responsibility. Information shall be complete and provided when requested.

System Integrator shall develop written testing and verification procedures for every aspect of system performance. Procedures shall include the criteria for acceptance. Procedures for correction and retesting in case of error or failure shall be included.

All affected parties shall review these procedures and the District shall approve the procedures prior to testing. Omissions or inadequacies in procedures do not relieve the System Integrator from providing a complete checkout, startup, and commissioning.

System Integrator shall, with the CONTRACTOR'S assistance, perform any other checks or testing, deemed necessary by the NEORSD ENGINEER or their representative, to demonstrate a fully functional system (or systems) and properly operating system(s) to the satisfaction of the NEORSD.

Tests shall be re-performed if there is a failure during all or part of a test or at the discretion of the NEORSD ENGINEER or their representative.

9.2.G - Integrity Testing

Electrical conductors shall be tested for continuity and insulation resistance according to industry standards and NEORSD requirements.

9.2.H - Calibration

All instrumentation, devices, and actuators shall have been calibrated and documented as such by the manufacturer before shipment to the Owner's site.

All instrumentation, devices, and actuators shall also be field calibrated after installation and before commencement of checkout and startup. Calibration services shall conform to the following requirements at a minimum:

- All sensors, elements, indicators, transmitters, and actuators shall be calibrated accordance with NIST-traceable standards following the manufacturer's instructions.
- All calibration equipment shall have current independent certification of accuracy.
- Calibration equipment shall have measurement accuracy that is a minimum of three times (3x) the expected accuracy of the device being calibrated.
- Actuators shall be stroked and control action, limits, and travel switches shall be verified.
- Each calibrated instrument shall be field-marked with a waterproof calibration tag bearing the device identifier (asset number or P&ID tag), date of calibration, calibration range (zero and span), units, remarks, (such as any special conditions found), trips, alarms, or other limit settings, and initials of the technician performing the work.
- An Instrument Certification sheet shall be completed for each instrument and included in the system documentation. A detailed description is given in Paragraph 9.2.O.

- A Final Control Element Certification sheet shall be completed for each field calibrated control valve, actuator, and damper, etc. and included in the system documentation. A detailed description is given in Paragraph 9.2.P.

9.2.I - System Checkout and Startup

CONTRACTOR must provide the services of qualified instrumentation and control system technicians, including, where applicable, those of System Integrator(s), instrument and control suppliers and equipment manufacturers to perform the following:

- Preparation of updates to all instrumentation and control documentation including, but not limited to drawings, process control narratives, I/O list, Component Setting Record and manuals.
- Check and approve the installation of all instrumentation and control components and all cable and wiring connections between the various system components prior to placing the various processes and equipment into operation for site acceptance testing.
- Conduct a complete system checkout and adjustment including calibration of all instruments, check of all loops, verification of setpoints and interlocks, and testing of final control actions.
- Check all communication networks including, but not limited to, serial communications, Modbus, Modbus Plus, DeviceNet, Profibus, Ethernet, ControlNet, fieldbus, etc. as applicable. All HMI and OIT graphics shall have been verified for completeness, functionality, and responsiveness during the FAT. During the FAT, all I/O shall be verified for proper linking to HMI and OIT graphical objectives/symbols, alarm and event logs, and recording in the Historian. All problems encountered shall be promptly corrected to prevent any delays in operational testing and startup of the various unit processes.

Field checkout, configuration, calibrations and adjustments associated with packaged process, mechanical and electrical equipment (e.g., chlorinators, samplers, variable-speed drives, packaged environmental and HVAC equipment and systems, fire alarm/protection systems and security systems, etc.) that have interfaces to the process control and automation system shall be performed by qualified, properly trained employees of the manufacturer or by manufacturer-authorized/recommended service providers. In general, standard documentation normally produced by the manufacturer or service provider attesting that the equipment has been properly installed, set up, and verified for the intended use will satisfy needed component documentation requirements.

CONTRACTOR must be required to plan and coordinate work to ensure there will be no unanticipated disruption in process operations and no hindrance of the District Representative's opportunity to witness calibration and loop checkout.

CONTRACTOR shall provide all test equipment necessary to perform the testing during system checkout and startup.

CONTRACTOR shall be responsible for initial operation of the instrumentation and control system and shall make any required changes, adjustments or replacements for operation,

monitoring, and control of the various processes and equipment necessary to perform the functions intended. Use Rockwell Software FactoryTalk AssetCentre application or other application acceptable to the District to track and manage changes.

CONTRACTOR shall verify, set, and record all ranges, spans, parameters, setpoints, engineering units, and other data required for the complete checkout and operation of the instrumentation and control system.

CONTRACTOR shall furnish to the ENGINEER certified calibration reports for field and panel instruments and devices specified in the Contract Documents as soon as calibration is completed.

Receipt of any calibration certificate by the District shall in no way imply acceptance of any portion of the work or any products furnished by the CONTRACTOR.

The calibration certificates shall be prepared and furnished by the CONTRACTOR. All calibration data pertinent to each individual instrument shall be provided on the calibration certificates.

Each calibration certificate shall be signed and dated by the person performing the calibration and by an authorized representative of the CONTRACTOR. Three copies of each completed certificate shall be submitted to the ENGINEER.

CONTRACTOR shall furnish to the ENGINEER two copies of an installation inspection report certifying that all equipment has been installed correctly and is operating properly. The report shall be signed by an authorized representative of the CONTRACTOR and the CONTRACTOR..

9.2.J - Commissioning

Following the instrumentation and control system checkout and initial operation, the System Integrator, under the supervision of the CONTRACTOR, shall perform a complete system test in the presence of the ENGINEER to verify that all equipment is operating properly as a fully integrated system and that the intended monitoring and control functions are fully implemented and operational. CONTRACTOR shall provide assistance to the System Integrator.

Commissioning can only begin when all instruments are installed, wired and field calibrated, the FAT successfully completed, and instrumentation and control documentation updated. All spare parts must be on site and accepted prior to Commissioning.

CONTRACTOR shall submit to the Engineer a schedule for Commissioning, including a proposed start date, at least three weeks in advance.

Commissioning shall include, as a minimum, the following checks:

All wiring shall be checked at each termination point for correct type, size, color, insulation, termination, and wire number.

9.2.K - Loop Verification

The proper wiring of each control loop shall be physically verified by the Contractor from the field device terminals to the control processor including every intervening panel, terminal, or device. Instruments and devices shall have been field-calibrated prior to conducting loop verifications. Cable, conductor, terminal board, and terminal designations shall be verified and documented as such on a copy of the loop diagram or equivalent schematic or wiring diagram.

Verification shall be by signal tracing, continuity verification, or “ringing out”. Tags and labels placed during construction shall not be considered adequate verification.

Each control loop shall be verified by injection of an appropriate pressure, resistance, voltage signal, or current signal. Use actual signals where available.

- Closely observe controllers, recorders, alarm and trip units, remote setpoints, ratio systems, and all other control and monitoring components. Observe HMI and OIT graphical screens to verify appropriate linking of I/O and the response of the graphical objects/symbols as well as associated alarm and event triggers displayed on graphical screens. Observe that logging of alarm and events associated with I/O are correct. Observe proper recording/archiving of I/O in the Historian. Make corrections as required where invalid readings or responses are observed. Following any corrections, retest the loop to verify proper operation.
- Stroke all control valves, cylinders, drives, actuators, dampers, and connecting linkages from each local and remote operator interface, including the control system operator interface.
- Check all hardwired interlocks to the maximum extent possible. In addition to any other as-recorded documents, record all setpoint and calibration changes on the appropriate system documentation.
- All analog PID control loops shall be tuned for optimum response using an appropriate loop tuning method and the resulting proportional, integral, and derivative values recorded on the loop checkout sheet.
- A Control Loop Checkout sheet shall be completed for each loop. A detailed description is given in Paragraph 9.2.Q.

9.2.L - Functional Performance Testing (FPT)

Performance testing of all systems should be performed to verify compliance with the specified sequences of operations, control descriptions, and control diagrams. Functional performance testing consists of executing written step-by-step procedures in which a condition is initiated or simulated and the response of the system is noted and compared to the specified or desired response. Functional performance tests must verify the following:

- Manual and automatic control modes.
- Normal system conditions and modes of operation.
- Contingency conditions and modes of operation.
- Effect of all operator controls.
- Operation of all interlocks and permissives.
- Confirmation of failure state of all outputs.
- Physical and information security measures.

If the configuration and programming of the PLC (programmable logic controller) or other controller, local HMI and/or remote HMI is in the System Integrator’s scope of work then corrections to the software, components, or systems are the responsibility of the System

Integrator. Corrections to these systems shall be done using Rockwell Software FactoryTalk AssetCentre or other District approved change management tools and procedures. It must be kept in mind that changes made to correct misoperation at one point in the PLC control sequence may inadvertently affect the performance of other control sequences that have already been tested and accepted. (See Re-Commissioning, Paragraph 9.2.M).

9.2.M - Re-commissioning

Whenever all or part of a SCADA system is modified, repaired, or replaced (by any party), re-commissioning is required to verify that the portions of the system affected function correctly and that the work has not affected other portions of the system. The extent of re-commissioning required shall be determined from the extent of the modifications.

For work that affects only devices and wiring external to the controller, the affected loops shall be verified and functionally tested.

For changes to controller program logic or settings, the entire process or subsystem supported by that controller shall be functionally tested, and the interface to the local and remote HMI verified. Control software changes shall be managed using Rockwell Software FactoryTalk AssetCentre application.

More extensive modifications may require re-commissioning of the complete SCADA system.

Functional performance testing for system certification must take place without operator intervention in the processor from beginning to end of the test. For this reason, a complete pre-test shall be conducted, using the full functional performance test procedure, prior to undertaking the certification test.

9.2.N - Availability testing

Before final turnover of the system to the NEORS D, the System Integrator shall be responsible for performing availability testing. The test shall determine system availability over a period of time to be determined by the NEORS D. Availability is defined as the ratio of uptime to uptime plus downtime. The passing availability ratio shall be determined by the NEORS D. For most tests downtime shall be equal to zero units of time.

If availability testing criteria are not met over the testing period, then the System Integrator shall re-start the testing from the beginning of the defined period of time.

9.2.O - Instrument Certification Sheet

Prior to loop and functional performance testing, all sensors and instruments shall be calibrated and documented using an Instrument Certification Sheet. Each Instrument Certification Sheet should include four sections as follows:

1. The Project and Instrument Description section which shall include:
 - Project Name
 - Project Location
 - District Project Number
 - Control Loop Number
 - Drawing References (such as P&ID, wiring diagram, etc.)

- Instrument Tag Number
 - Asset Number (if assigned)
 - Instrument Description
 - Instrument location
 - Instrument manufacturer
 - Instrument model number
 - Instrument serial number, if applicable
 - Instrument range
 - Calibrated signal range
 - Instrument setpoint and deadband (for switches)
2. Calibration equipment section: The certification sheet shall include the following information on the calibration equipment used:
- Type of Device
 - Manufacturer and Model Number
 - Accuracy
 - NIST Traceability (Yes/No)
3. Calibration Results section: The calibration results shall be entered on a table that is suitably sized and formatted for the type of instrument/device being calibrated. This include:
- A table to record the calibration of analog instrumentation and devices such as transmitters, analyzers and indicators
 - A table to record the calibration of process switches and other field-configurable/calibratable sensing devices

A record of the transmitter, analyzer and indicator calibrations shall contain the following data for both increasing and decreasing input signals at 0, 25, 50, 75, and 100 percent of span:

- Input value
- Output value
- Integral display reading (for instruments having a factory installed display
- Span: the difference between the Maximum (upper range value) and Minimum (lower range value) calibrated values of the instrument
- Error: $((\text{Output} - \text{Input}) / \text{Span}) \times 100 \%$

A record of the process switch calibrations shall contain the following data for both increasing and decreasing inputs at all setpoints:

- Setpoint value

- Operate value
 - Reset value
 - Error: (Setpoint value – Operate value) units
4. Attestation Section: The calibration sheet shall include the following information identifying the persons responsible for performing the calibration and witnessing the calibration:
- Printed name and dated signature of the SI/I&C SubCONTRACTOR Representative responsible for the calibration.
 - Printed name and dated signature of the District's Representative responsible for witnessing the calibration.
 - Printed name, dated signature, and company affiliation of the lead person that actually performed the calibration.

9.2.P - Final Control Element Certification Sheet

Valve actuators and other final control elements shall be calibrated and documented. A final control element certification sheet shall include four sections:

1. The Project and Final Control Element Description Section which shall include the following information:
 - Project Name
 - Project Location
 - District Project Number
 - Control Loop Number
 - Drawing References (such as P&ID, wiring diagram, etc.)
 - Control Valve Tag Number
 - Asset Number (if assigned)
 - Control Valve Description
 - Control Valve Location
 - Control Valve Manufacturer
 - Control Valve Model Number
 - Control Valve Serial Number, if applicable
 - Control Valve Actuator (Pneumatic or Electric)
 - Control Valve Positioner (Direct or Reverse), if applicable
 - Control Valve Positioner Input and Output Signal, if applicable
 - Control Valve I/P Converter Input and Output Signal, if applicable

- Control Valve Failure Mode (open or close) on air failure, if applicable
 - Control Valve Failure Mode (open or close) on signal loss, if applicable
2. The Calibration Equipment Section: The certification sheet shall include the following information on the calibration equipment used.
- Type of Device
 - Manufacturer and Model Number
 - Accuracy
 - NIST Traceability (Yes/No)
3. Calibration Results section: The calibration results shall include a table that is suitably sized and formatted for the type of final control element being calibrated and the completeness of the specified calibration requirements.
- A table to record the calibration of the I/P (current to pneumatic) converter, if applicable
 - A table to record the calibration of the final control element
 - A record of the I/P (current to pneumatic) converter calibration shall contain the following data for both increasing and decreasing inputs at 0, 25, 50, 75, and 100 percent of span:
 - a) Input value
 - b) Output value
 - c) Error $((\text{Output} - \text{Input})/\text{Span}) \times 100 \%$
 - A record of the final control element calibration shall contain the following data for both increasing and decreasing inputs at 0, 25, 50, 75, and 100 percent of span:
 - a) Input value
 - b) Output travel (position) Travel: the valve percent open (not all valves are linear)
 - c) Error $((\text{Output} - \text{Input})/\text{Span}) \times 100 \%$
4. Attestation Section: The calibration sheet shall include the following information identifying the persons responsible for performing the calibration and witnessing the calibration:
- Printed name and dated signature of the SI/I&C Sub-CONTRACTOR Representative responsible for the calibration.
 - Printed name and dated signature of the District's Representative responsible for witnessing the calibration.
 - Printed name and dated signature and company affiliation of the lead person that actually performed the calibration.

Analog Loop Signal Processing and Operator Interface Device Certification Sheet

Prior to loop and functional performance testing, all analog loop signal processing devices (e.g., hardwired signal converters and function relays), and operator interface devices (e.g., panel-mounted process indicators, loading stations, controllers) shall be calibrated/configured and documented using a Loop Signal Processing Device and Operator Interface Device Certification Sheet. Each Loop Signal Processing Device and Operator Interface Device Certification Sheet should include four sections as follows:

5. The Project and Device Description section which shall include:
 - Project Name
 - Project Location
 - District Project Number
 - Control Loop Number
 - Drawing References (such as P&ID, wiring diagram, etc.)
 - Instrument Tag Number
 - Instrument Description
 - Instrument location
 - Instrument manufacturer
 - Instrument model number
 - Instrument serial number, if applicable
 - Instrument range
 - Instrument setpoint and deadband (as applicable)
6. Calibration equipment section: The certification sheet shall include the following information on the calibration equipment used:
 - Type of Device
 - Manufacturer and Model Number
 - Accuracy
 - NIST Traceability (Yes/No)
7. Calibration Results section: The calibration results shall be entered on a table that is suitably sized and formatted for the type of instrument/device being calibrated. This includes:
 - A table to record the calibration of analog loop devices
 - A table to record the calibration of process event trips

- A record of the analog device calibration shall contain the following data for both increasing and decreasing input signals at 0, 25, 50, 75, and 100 percent of span:
 - a) Input value
 - b) Output value
 - c) Display reading
 - d) Span: the difference between the Maximum (upper range value) and Minimum (lower range value) calibrated values of the instrument
 - e) Error: $(\text{Output} - \text{Input}) / \text{Span} \times 100\%$
 - A record of the process event trip calibrations shall contain the following data for both increasing and decreasing inputs at all setpoints:
 - a) Setpoint value
 - b) Operate value
 - c) [Reset value]
 - d) Error: (Setpoint value – Operate value) units
8. Attestation Section: The calibration sheet shall include the following information identifying the persons responsible for performing the calibration and witnessing the calibration:
- Printed name and dated signature of the CONTRACTOR's Representative responsible for the calibration.
 - Printed name and dated signature of the District's Representative responsible for witnessing the calibration.
 - Printed name and dated signature and company affiliation of the lead person that actually performed the calibration.

9.2.Q - Control Loop Checkout Sheet

The Contractor shall perform loop checkouts for each control loop in the system and provide suitable documentation certifying that the loop is properly tuned and operating correctly. Record keeping and generation of documentation shall be facilitated electronically with the use of MS Excel spreadsheet or MS Access applications, at the preference of the District. The control loop checkout sheet shall have a section verifying each of the six steps described below. When these have been verified and signed off, the functional performance testing (FPT) can be started.

- Verify mechanical field installation and that there are no leaks
 - a) Motors and Pumps
 - b) Valves and Dampers
- Verify that all Instruments are calibrated correctly for the specified ranges and setpoints

- a) Pressure Instruments
- b) Flow Instruments
- c) Level Instruments
- d) Temperature Instruments
- e) Analysis Instruments
- Verify electrical power wiring
 - a) Incoming power sources for proper voltage
 - b) Field and panel cables properly installed and identified
 - c) Circuit breakers sized and operating correctly
 - d) Fuses sized correctly
- Verify control system Input and Output wiring
 - a) Digital inputs (for example, switches)
 - b) Digital outputs (for example, on / off signals)
 - c) Analog inputs (transmitters)
 - d) Analog outputs (VFDs, valves, and meters)
- Verify software logic is complete
 - a) Correct programs are loaded
 - b) Factory Acceptance Test (FAT) thoroughly completed
 - c) Software Management Practices in place
- Verify HMI (or OIT) points and displays are complete
 - a) Graphic screens and screen navigation
 - b) Alarm screens and operator actions
 - c) Trend Displays and Data Archiving configured properly

The I/O checkout software logic and HMI / OIT should have been verified during the factory acceptance test.

The Control Loop Checkout Sheet shall have a section verifying each of the steps described above. When these have been verified and signed off, the Functional Performance Testing can be started.

All instruments and devices shall be checked to verify compliance with the specifications and approved shop drawings. The calibration of analog devices shall be verified including the zero and span.

Analog wiring shall be checked for correct polarity and ground continuity at each termination point in the loop.

All analog loops shall be verified at each termination point at 0%, 25%, 50%, 75%, and 100% signal levels.

CONTRACTOR shall provide the following documentation for use during the Commissioning effort. This documentation is in addition to any documentation required by the Contract.

Complete field wiring and loop diagrams

Completed Calibration Certificates for all field devices which require adjustment or calibration.

CONTRACTOR shall provide one set of Commissioning documentation for the OWNER'S personnel, one set for the ENGINEER'S use, one set for field use, and the required number of sets for the CONTRACTOR'S use.

The documents corrected and modified during commissioning shall form the basis for the "As-Built" set of drawings. Updates to documents and drawings shall be done electronically. Hand-marked "As-Built" documents are not acceptable.

9.2.R - I/O Checkout Certification Sheet

The I/O Checkout sheet certifies correctness of assignments of I/O, configuration of I/O modules, and associations between I/O and control system HMI, OIT, alarm log, event log, and Historian applications. Checkout with regard to HMI and OIT shall include process and maintenance/diagnostics screen verification. The I/O checkout certification sheet shall be completed during the Factory Acceptance Test for each I/O to document verification and shall consist of the following sections.

9. The Project and Instrument/Field Device Description section which shall include:

- Project Name
- Project Location
- District Project Number
- I/O Point Tag Number (see Part II, 1.9 for Wonderware HMI)
- I/O Point Connection Address (physical/wired address; e.g., PLC/Rack/Position/Channel and networked address PLC/DeviceNet network/node (see Part V Section 5.3.B))
- Drawing References (such as P&ID, loop drawing, wiring diagram, etc.)
- Instrument/Field Device Tag Number
- [Instrument Asset Number (if assigned by District)]
- Instrument/Field Device Description
- Instrument/Field Device location
- Instrument/Field Device range
- Instrument/Field Device setpoint and deadband (as applicable)

10. I/O generation section: The certification sheet shall include the following information describing the generation method (physical or simulated) used for each I/O tested:

- I/O generation method (physical or simulated)
- Test signal engineering units and span
- Test Equipment Manufacturer/Model No./NIST calibration date (physical I/O generation)

A record of the analog I/O checkout shall contain the following data for both increasing and decreasing input signals at 0, 25, 50, 75, and 100 percent of normal operating span. In addition, analog I/O shall be verified for out of range (bad quality).

- Input value and corresponding engineering units
- Output value and corresponding engineering units
- Low bad signal quality limit value
- High bad signal quality limit value

11. HMI, OIT Graphical Interface verification section: The certification sheet shall include the following information about each graphical window of each system graphical interface that utilizes the I/O:

1. Type of graphical interface (HMI (Wonderware), OIT (PanelView))
2. OIT Application Name
3. Graphical interface graphic window name (see Part V, Section 2.10F for HMI window names and Part V, Section 4.4B for OIT display names)
4. Graphical object tag number
5. Graphical symbol

12. Attestation section: The I/O Checkout certification sheet shall include the following information identifying the persons responsible for performing and witnessing the I/O checkout:

6. Printed name and dated signature of the SI/I&C Subcontractor Representative responsible for the I/O checkout.
7. Printed name and dated signature of the District's Representative responsible for witnessing the I/O checkout.
8. Printed name and dated signature and company affiliation of the lead person that actually performed the I/O checkout.

9.2.S - Component Settings Record

The Contractor shall document all programming configuration settings associated with I/O points created, added, or modified under the project in the Component Settings Record. The Component Settings Record shall be a spreadsheet that documents each signal type and range, high and low signal range limits, alarm and operating limits, trip settings, discrete point open/closed signal state descriptors, filters, and deadbands associated with each I/O point. It

shall identify the Project Name, Project Location, District Project Number and shall include the following information fields:

9. I/O, instrument/field device identification fields:

- I/O Point Tag Number (see Part II, 1.9 for Wonderware HMI)
- I/O point description
- I/O point type (distinguish networked I/O by suffix designating network type (e.g., “-DN” (DeviceNet), “-MB” (Modbus))
- I/O Point Connection Address (physical/wired address; e.g., PLC/Rack/Position/Channel and networked address PLC/DeviceNet network/node (see Part V Section 5.3.B)
- Drawing References (such as P&ID, panel drawing, loop drawing, wiring diagram, etc.)
- Instrument/Field Device Tag Number and Asset Number
- Analog I/O point signal and process parameter definition fields
- I/O raw signal engineering units (e.g., millivolts, volts, milliamps, psig, etc.)
- Analog I/O raw signal span minimum value and maximum value (e.g., 4-20, 1-5, 24vDC, etc.)
- I/O signal process parameter engineering units
- I/O signal process parameter span minimum value and maximum value
- Low bad signal quality limits lower value, upper value

10. Discrete I/O point signal and process parameter definition fields

- Set state function description
- Reset state function description

11. I/O point user interface association fields

- HMI (none, AOI, UDT)
- HMI Node and User Control Prohibit (identify nodes and user group types that are not permitted to affect output state or value)
- OIT (none, AOI, UDT)
- OIT User Control Prohibit (identify user group types that are not permitted to affect output state or value)

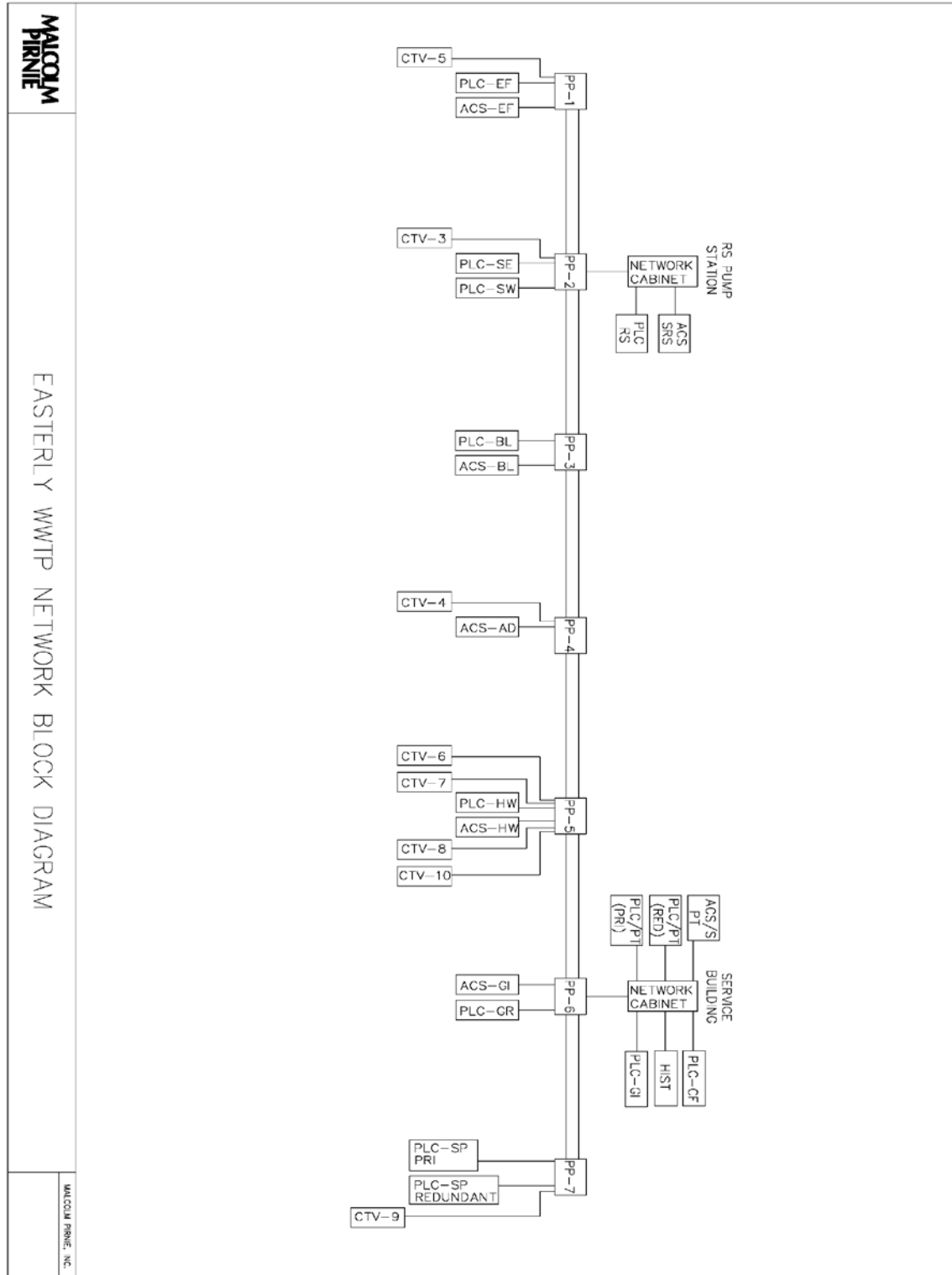
12. I/O point signal and process parameter alarm, trend and historian definition fields

- I/O raw signal engineering units
- I/O raw signal Low-Low Alarm value, Low Alarm value, High Alarm value, High-High Alarm value

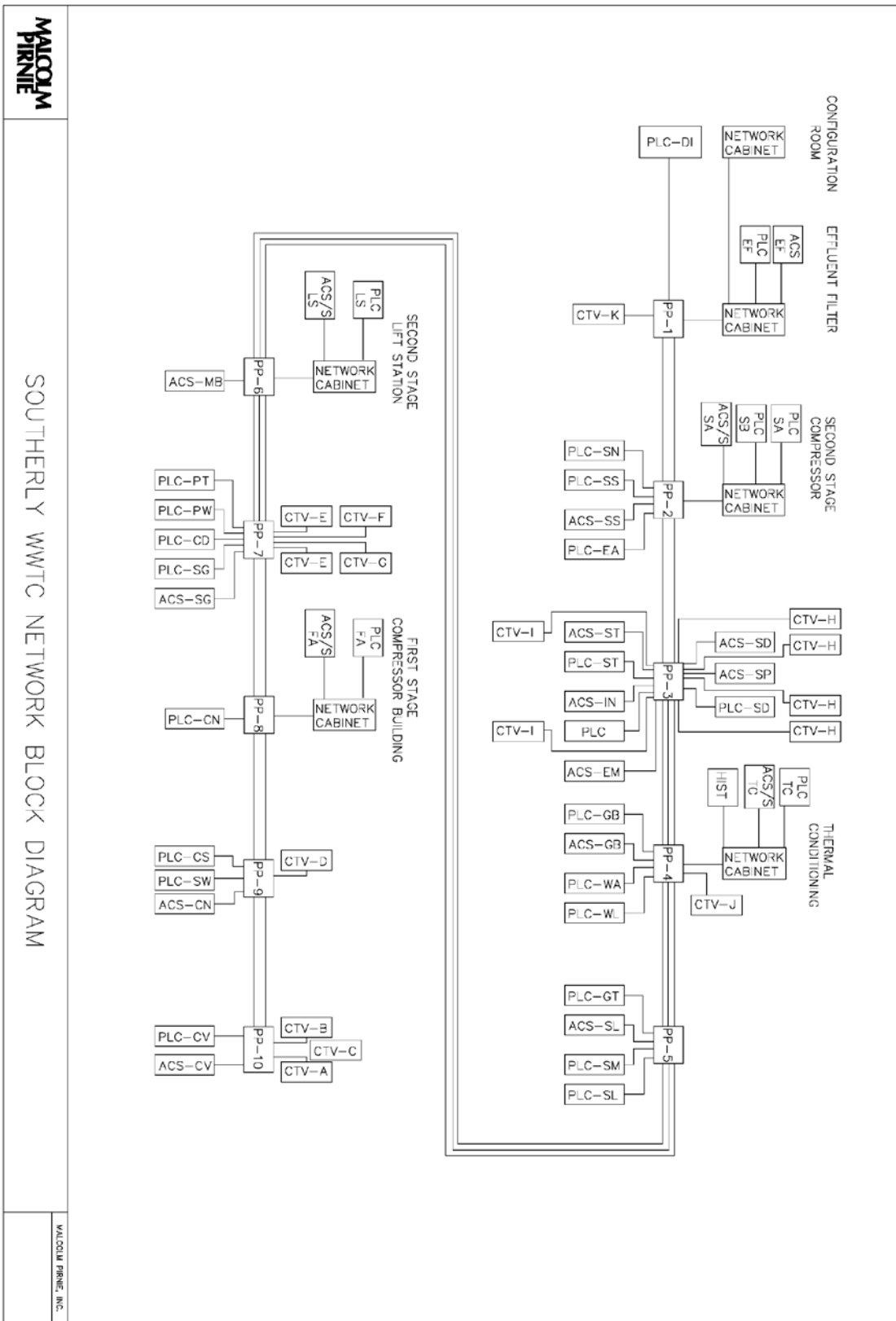
- I/O signal process parameter engineering units
- I/O signal process parameter Low-Low Alarm value, Low Alarm value, High Alarm value, High-High Alarm value
- Alarm deadband
- Alarm initiation delay time
- Alarm cut-out delay time
- Alarm priority rating
- HMI Trended point
- OIT Trended point
- Historical data capture criteria and conditions (none, sampling period, exception deadband, max time between archived samples, rate-of-change limit, other criteria as applicable)]

Part III CONTROL NETWORK

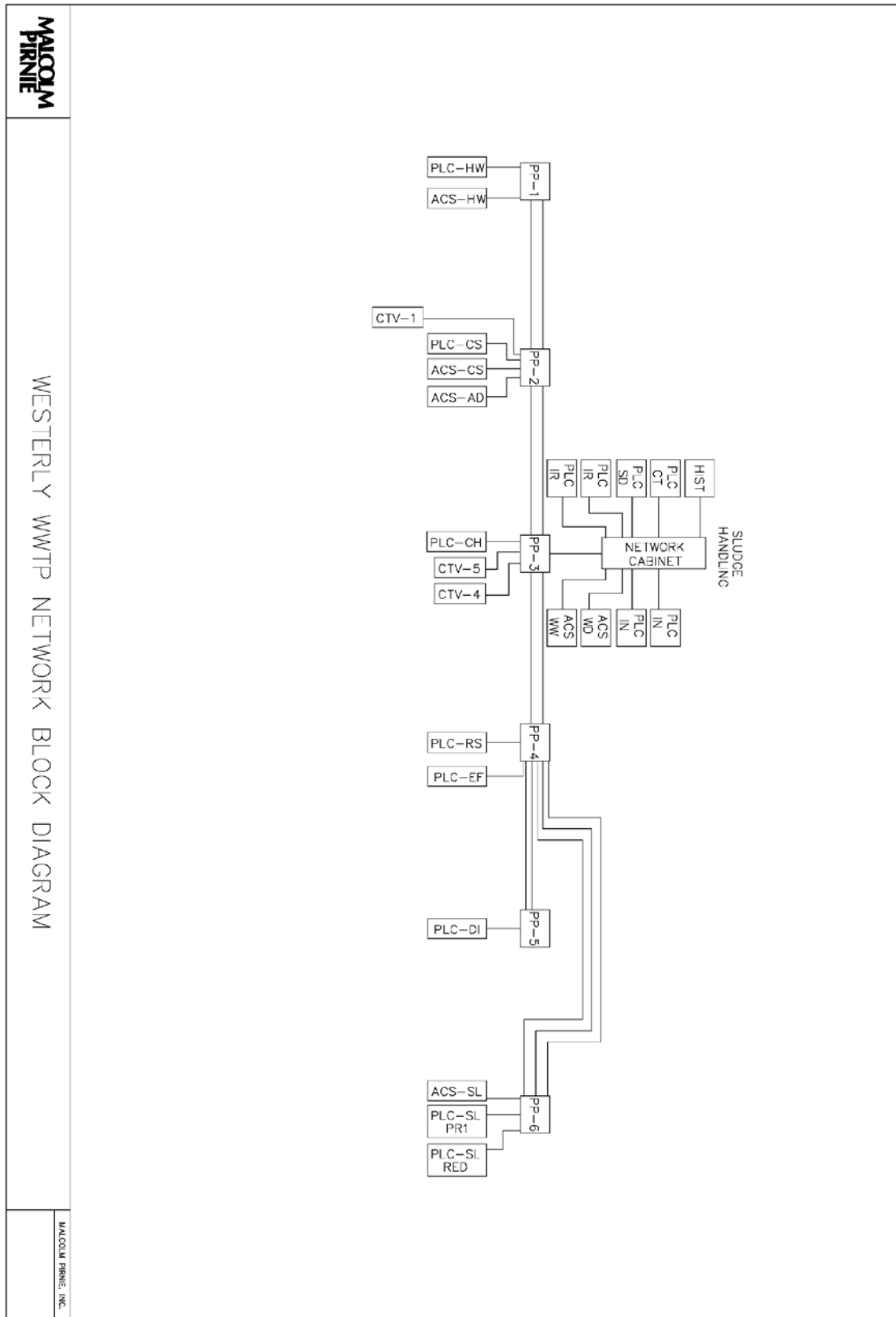
SECTION 1 - EASTERLY WWTP NETWORK BLOCK DIAGRAM



SECTION 2 - SOUTHERLY WWTC NETWORK BLOCK DIAGRAM



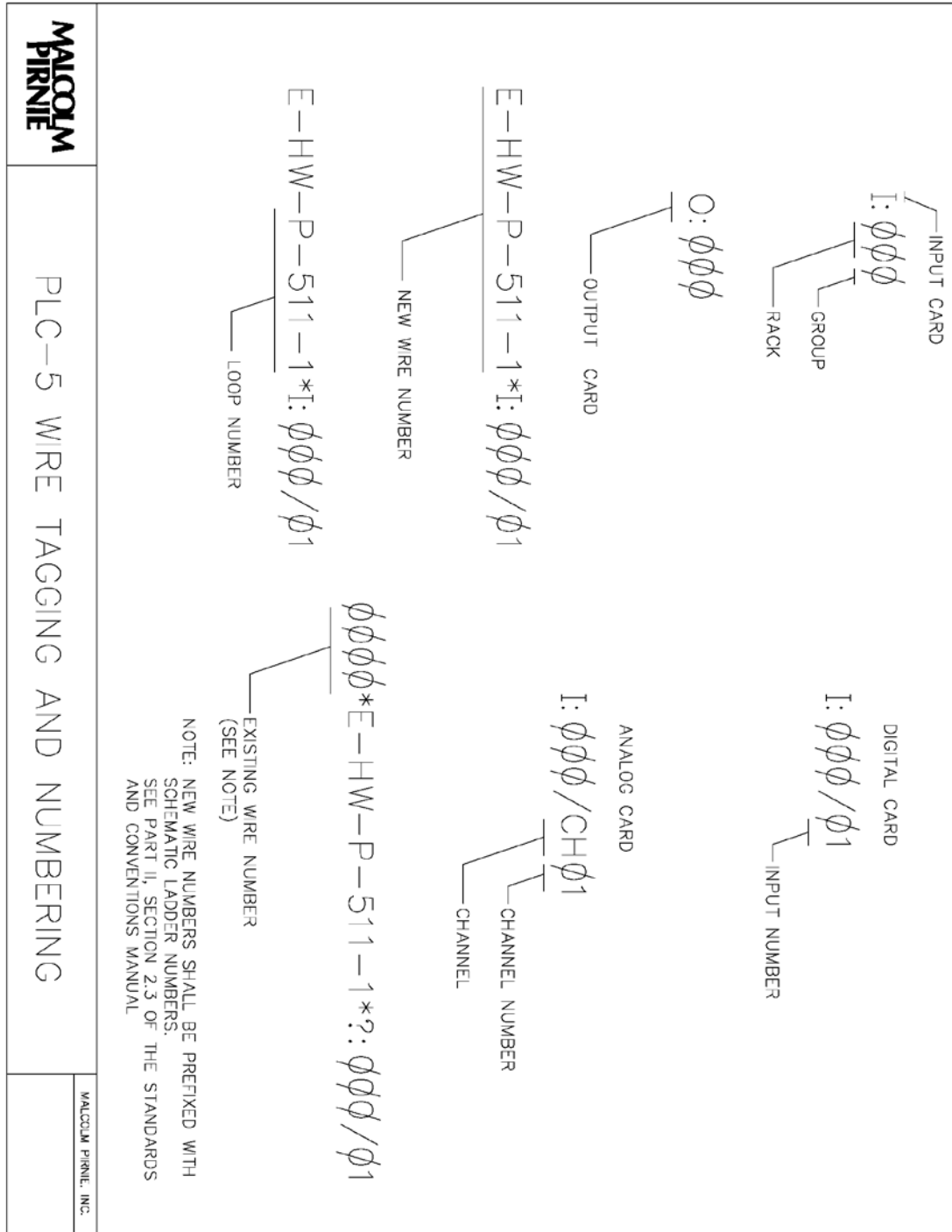
SECTION 3 - WESTERLY WWTC NETWORK BLOCK DIAGRAM



Part IV APPENDICES

SECTION 1 - WIRE TAGGING AND NUMBERING CONVENTION

Section 1.0 - PLC-5 Wire Tagging and Numbering Convention



FORMAT: "R#-S#-CH#(+ OR -)-INSTRUMENT TAG"

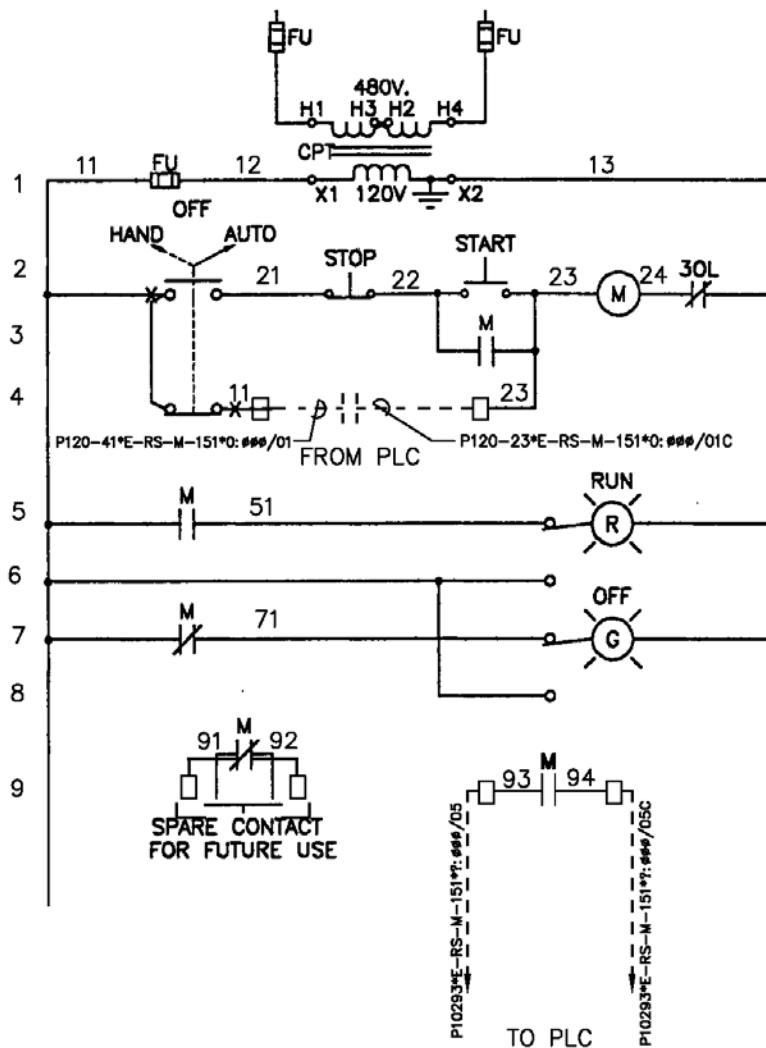
WHERE: R# = RACK NUMBER (RACK ASSIGNMENTS START WITH "0" FOR THE LOCAL RACK)
 S# = SLOT NUMBER
 CH# = CHANNEL NUMBER
 + OR - = THE POLARITY ASSOCIATED WITH THE SPECIFIC WIRE FOR AN ANALOG INSTRUMENT
 INSTRUMENT TAG = SM-Z-...-Z-MNXX
 (AS DEFINED IN PART II SECTION 9.1)
 S = SITE
 AA = PROCESS AREA NUMBER
 Z...Z = ISA ALPHA CHARACTER FOR INSTRUMENT FUNCTION
 MNXX = LOOP NUMBER

EXAMPLES:

RO-S6-CH4+-S-47-PIT-2600
 (FOR SOUTHERLY INCREASING PRE-STRAINER PRESSURE "I" SIGNAL WIRE)
 RI-S2-CH18-S-47-LSH-2606
 (FOR SOUTHERLY INCREASING PROCESS WATER TANK LEVEL HIGH ALARM CONTROL WIRE)
 RO-S8-CH2-S-57-ZSC-A302
 (FOR SOUTHERLY BOSCHIDS HANDLING CENTRIFUGE 2A CONTROL VALVE CLOSED STATUS)
 IN CASES WHERE A DEVICE HAS MULTIPLE SIGNALS, ADD AN "A" OR "B" TO THE END OF THE TAG:
 RO-S6-CH4+-S-47-PIT-2600-A (ONE ANALOG SIGNAL) AND
 RO-S6-CH4+-S-47-PIT-2600-B (A SECOND SIGNAL FROM THE SAME INSTRUMENT)
 IF THERE WERE 2 DEVICES ON THE SAME LOOP, EACH WITH 2 OUTPUTS, THE TAG WOULD TAKE THE FOLLOWING FORM:
 RO-S6-CH4+-S-47-PIT-2600A-A & RO-S6-CH4+-S-47-PIT-2600A-B
 RO-S6-CH4+-S-47-PIT-2600B-A & RO-S6-CH4+-S-47-PIT-2600B-B

SECTION 2 - SAMPLE CONTROL SCHEMATIC WITH PLC-5 WIRE TAGGING

NOTE: WIRE NUMBERS THAT CONNECT TO PLC
SHALL BE LABELED WITH SCHEMATIC WIRE NUMBER
AND PLC WIRING TAG.

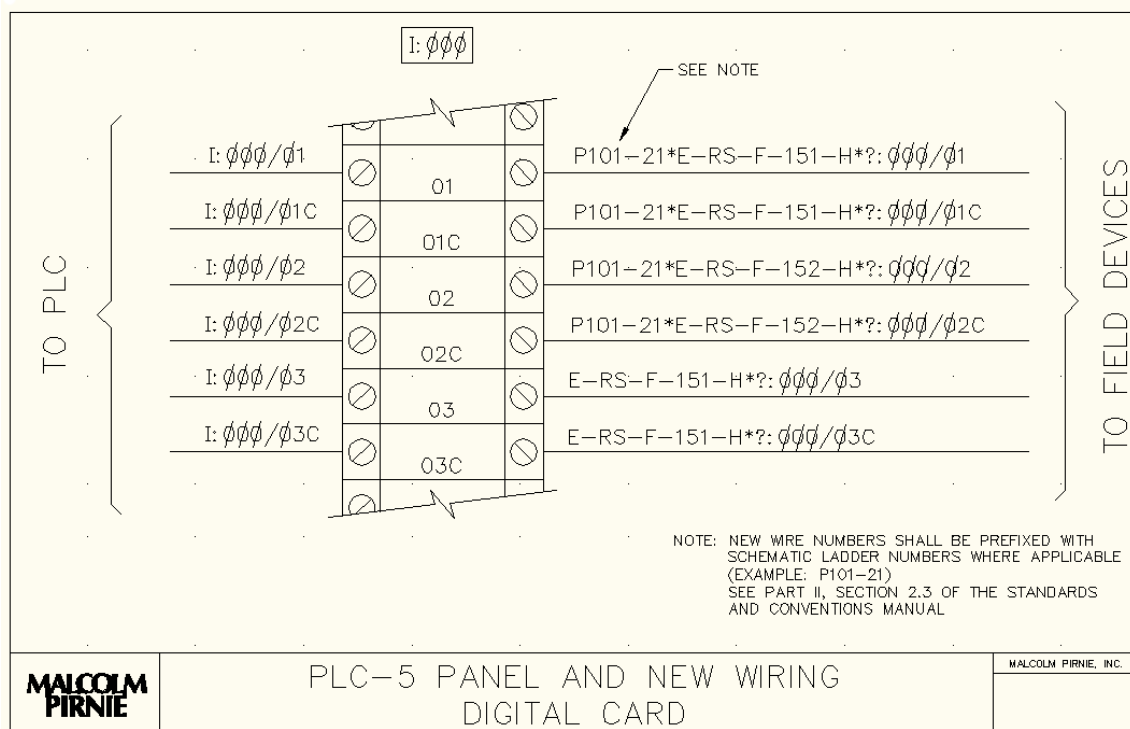
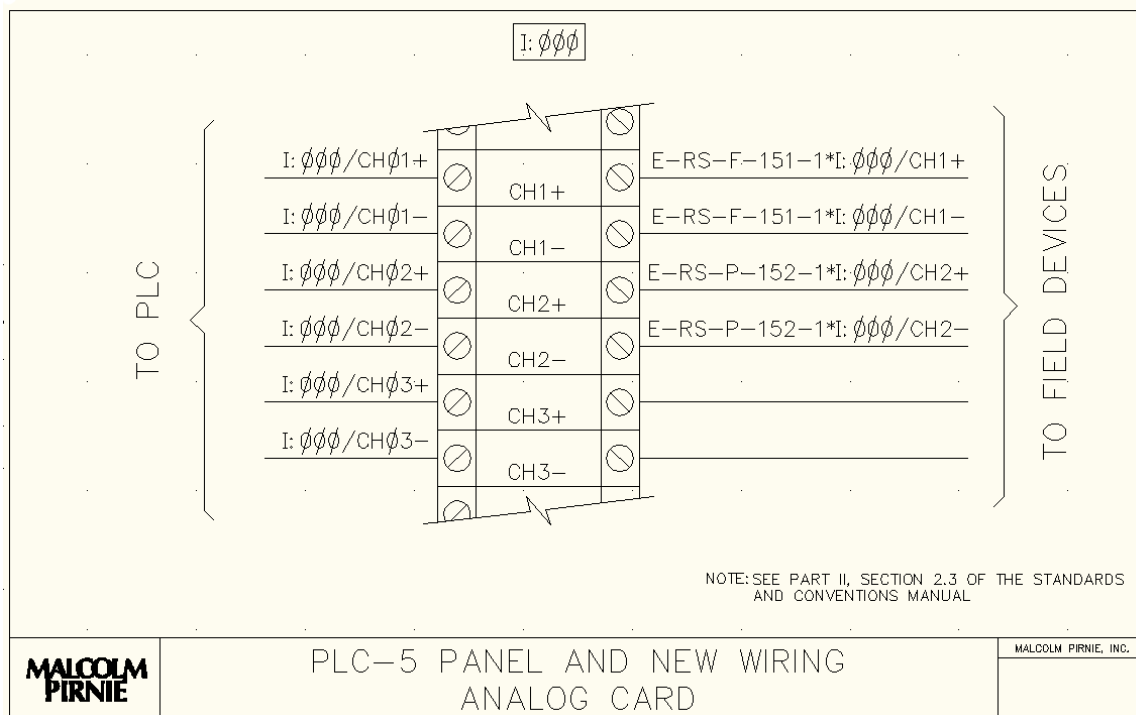


**MALCOLM
PIRNIE**

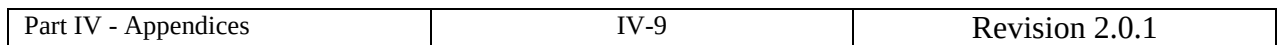
SAMPLE CONTROL SCHEMATIC
WITH TERMINATIONS AT PLC-5

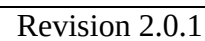
MALCOLM PIRNIE, INC.

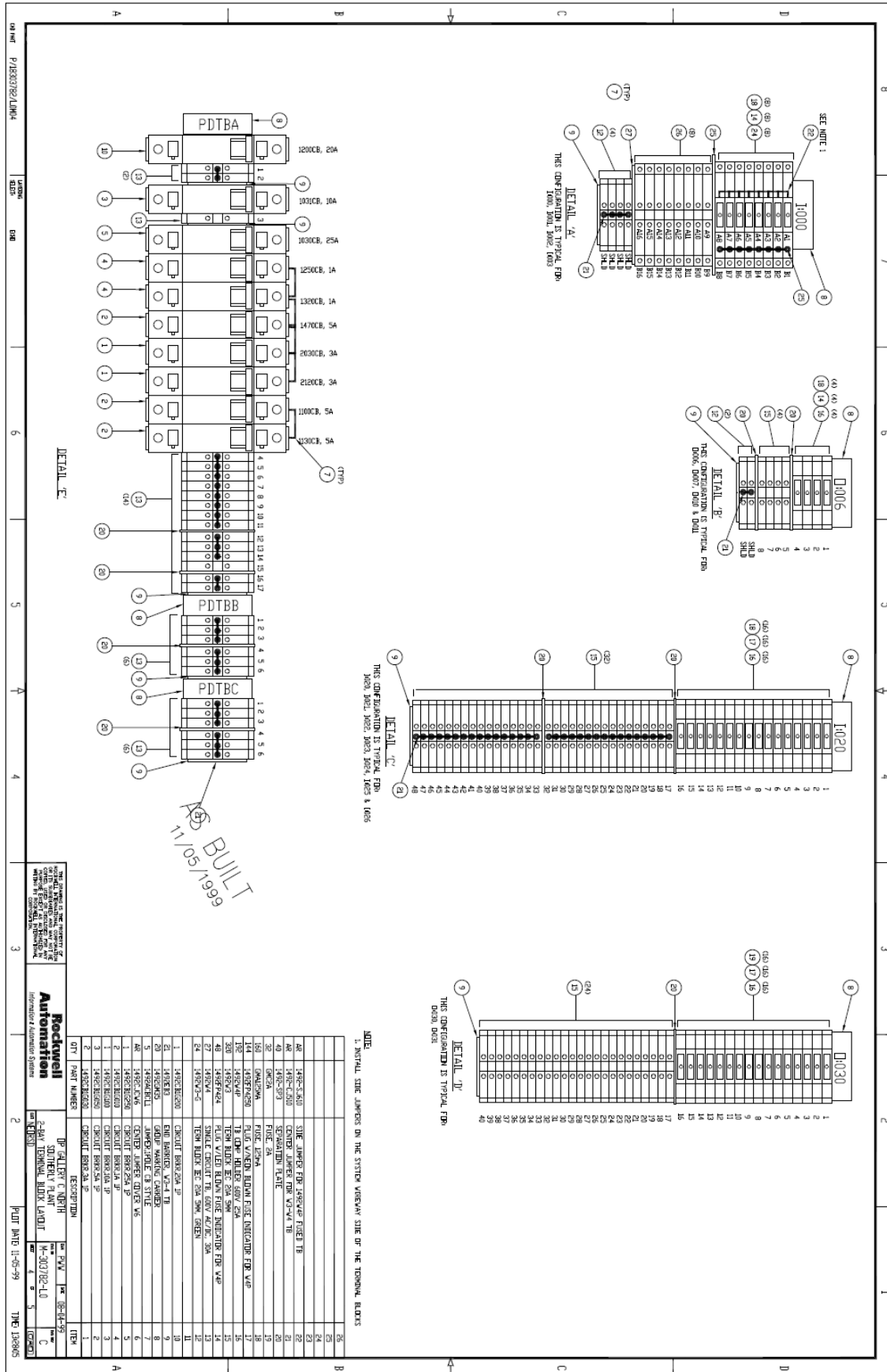
SECTION 3 - PLC-5 PANEL SAMPLE INTERPOSING TERMINAL WIRE TAGGING

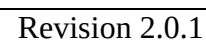


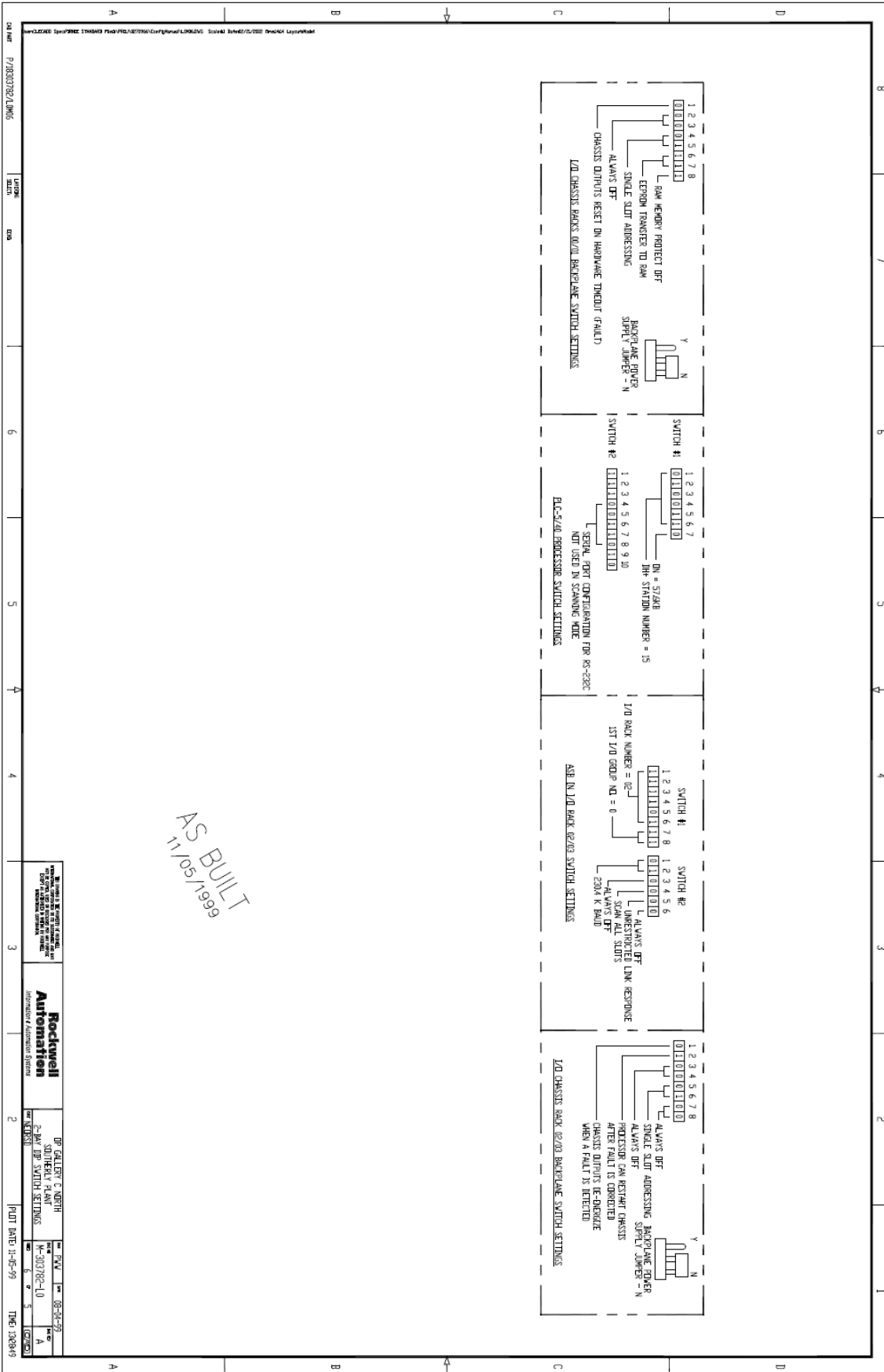
[illegible]











SECTION 7 - PROCESS, EQUIPMENT, AND PARAMETER ABBREVIATIONS

Section 7.0 - Process Abbreviations

PROCESS ABBREVIATIONS	
AA	AMBIENT AIR
AMN	AMMONIA
AS	ASH SLURRY
ASW	ATTEMPERATOR SPRAY WATER
BLDN	BLOWDOWN
BMS	BURNER MANAGEMENT SYSTEM
BFW	BOILER FEED WATER
BUS	ELECTRICAL BUS
CA	COMPRESSED AIR
CCW	CONDENSATE COOLING WATER
CEN	CENTRATE
CF	CENTRIFUGE FEED
CG	CALIBRATION GAS
CH	COOLING WATER
CMBA	COMBUSTION AIR
CN	CONDENSATE (STEAM)
CR	CONDENSATE RETURN
CW	COLD WATER
DA	DRY ASH
DAF	DISSOLVED AIR FLOTATION
DI	DISINFECION
DO	DISSOLVED OXYGEN
DB	DEWATERED BIOSOLIDS
DES	DEGRITTED EASTERLY SLUDGE
DISCHG	DISCHARGE (GENERAL)
DR	DRAIN
DSS	DEGRITTED SCREENINGS AND STRAININGS (OR SLUDGE)
DW	DILUTION WATER
DMW	DE-MINERAILIZED WATER
EAS	EXCESS ACTIVATED SLUDGE
EG	EXHAUST GAS
EF_#	EFFLUENT (#= PLC ID)
ES	EASTERLY SLUDGE

	<u>PROCESS ABBREVIATIONS</u>
ESK	EASTERLY SKIMMINGS
ER	ENERGY RECOVERY
FA	FLUIDIZING AIR
FOA	FOUL AIR
GBT	GRAVITY BELT THICKENER
GT	GRAVITY THICKENER
GRS	GREASE
GTO	GRAVITY THICKENER OVERFLOW
HFA	HEATED FLUIDIZING AIR
HG	HOT GAS
HW	HOT WATER
HWR	HOT WATER RETURN
HWS	HOT WATER SUPPLY
IA	INSTRUMENT AIR
IM	IMPULSE LINE
IN	INLET or INTAKE (GENERAL)
INC	INCINERATION
ING	INJECTED NATURAL GAS
LS	LIFT STATION
MU	MAKEUP WATER
NG	NATURAL GAS
NPW	NON-POTABLE WATER
OF	OVERFLOW
OS	OXYGEN SCAVENGER
OT	OBJECT TRAP
OUT	OUTLET (GENERAL)
PA	PURGE AIR
PHOS	PHOSPHATE
PNG	PILOT NATURAL GAS
POL	POLYMER
PHFA	PREHEATED FLUIDIZED AIR
PRW	PROCESS WATER
PSH	PRIMARY SUPERHEATER
PW	POTABLE WATER (CITY WATER)
RW	RECIRCULATION WATER

	<u>PROCESS ABBREVIATIONS</u>
SA	SECOND STAGE AERATION
SAN	SANITARY
SBS	STORED BIOSOLIDS
SFH	SLUDGE FEED HEADER
SG	SCRUBBED GAS
SHST	SUPERHEATED STEAM
SK	SKIMMINGS
SND	SAND
SPH	SODIUM PHOSPHATE
SR	SLUDGE RECYCLE
SS	SLUDGE STORAGE
SSH	SLUDGE SUCTION HEADER
SSW	SCRUBBER SOLUTION WATER
ST	STEAM
STM	STORM WATER
SUC	SUCTION (GENERAL)
SVT	SAND VENT
SW	SEAL WATER
SWH	SLUDGE WITHDRAWAL HEADER
TCSTO	THERMALLY CONDITIONED SLUDGE THICKENER OVERFLOW
TEAS	THICKENED EXCESS ACTIVATED SLUDGE
TPS	THICKENED PRIMARY SLUDGE
TICS	THICKENED THERMALLY CONDITIONED SLUDGE
TU	TRUCK UNLOADING
VFWL	VACUUM FILTER WASTE LIQUOR (CENTRATE)
VT	VENT
WD	WITHDRAWAL
WHR	WASTE HEAT RETURN
WHS	WASTE HEAT SUPPLY
WL	WASTE LIQUOR
WTS	WATER TREATMENT SYSTEM

Section 7.1 - Equipment Abbreviations

EQUIPMENT ABBREVIATIONS	
ABS	AUTOMATIC BACKWASH STRAINER
AD	AIR DRYER
AS	AIR SEPARATOR
ASF	(TWIN) AUGER SCREW FEEDER
B	BOILER
BFC	BIOFILTER CELL
BFP	BACKFLOW PREVENTER
BHU	BIN HYDRAULIC UNIT
BIN	STORAGE BIN
BKR	BREAKER
BLW	BLOWER (was BL)
BP	BOOSTER PUMP
BU	BLENDING UNIT
BYP	BYPASS (GENERAL)
CCT	CHLORINE CONTACT TANK
CEMS	CONTINUOUS EMISSIONS MONITORING SYSTEM
CHHX	COOLING WATER HEAT EXCHANGER
CHP	COOLING WATER PUMP
CNT	CENTRIFUGE (was CN)
CND	CONDENSATE DEAERATOR
CNP	CONDENSATE PUMP
CP	COMPRESSOR
CTP	CONDENSATE TRANSFER PUMP
DAD	DESICCANT AIR DRYER
DAR	DRY AIR RECEIVER
DS	DUPLEX STRAINER
DSP	DOM E SPRAY PUMP
DMP	DAMPER
DTNK	DAY TANK
DWO	DRY WEATHER OVERFLOW
EC	ECONIMIZER
EJ	EXPANSION JOINTS
ET	EXPANSION TANK
F	FAN
FB	FREE BOARD
FBKR	FEEDER BREAKER
FIB	FAN INBOARD BEARING
FIL	FILTER
FLP	FLUSHING PUMP
FOB	FAN OUTBOARD BEARING

	<u>Equipment Abbreviations</u>
FOA	FOUL AIR
FP	FEED PUMP
FPRT	FEEDER PROTECTION
FS	FILTER/SILENCER
FST	FIRST STAGE SETTLING TANK
FWP	FEED WATER PUMP
G	GRINDER
GHU	GATE HYDRAULIC UNIT
HG	HORIZONTAL GATE
HOP	HOPPER
HPT	HYDROPNEUMATIC TANK
HUM	HUMIDIFIER
HX	HEAT EXCHANGER
IDF	INDUCED DRAFT FAN
IFP	INCINERATOR FEED PUMP
IRR	IRRIGATE OR IRRIGATOR
INC	INCINERATOR, FLUIDIZED BED (was FBI)
INS	INLET SILENCER
LL	LEAD-LAG
MBKR	MAIN BREAKER
MIB	MOTOR INBOARD BEARING
MIST	MIST ELIMINATOR
MOB	MOTOR OUTBOARD BEARING
MON	MONORAIL
MP	MIXING PUMP
MX	MIXER
NGLS	NATURAL GAS LANCE SYSTEM
NGS	NATURAL GAS SYSTEM
P	PUMP
PAC	PROCESS AIR COMPRESSOR
PAT	POLYMER AGING TANK
PBU	POLYMER BLENDING UNIT
PCS	PRE-COOLER SECTION
PHB	PRE-HEAT BURNER
PHBS	PRE-HEAT BURNER FUEL SUPPLY
PHU	PUMP HYDRAULIC UNIT
PHX	PRIMARY HEAT EXCHANGER
PLP	PIPE LUBRICATION PUMP
PWRM	POWER MONITOR
PST	PRIMARY SKIMMING (OR SETTLING) TANKS
PRTR	PROTECTION RELAY
RAD	REFRIGERATED AIR DRYER
RP	RECIRCULATION PUMP
RST	RECTANGULAR STORAGE TANK

	<u>Equipment Abbreviations</u>
SB	SOOT BLOWER
SBCS	SOOT BLOWER CONTROL STATION
SC	SCREW CONVEYOR
SD	STEAM DRUM
SG	SLIDE GATE
SGU	STEAM GENERATOR UNIT
SHX	SECONDARY HEAT EXCHANGER
SIL	SILO
SP	SUMP PUMP
SPF	SLIDING PLATE FRAME
SPS	STANDBY POWER SUPPLY
SSB	SECOND STAGE BLOWER
SST	SECOND STAGE SETTLING TANK
STC	STEAM CONDENSER
STK	STACK
STL	STEAM TURBINE LUBE SYSTEM
STNK	STORAGE TANK
STR	STRAINER
STU	STEAM TURBINE UNIT
SV	SOLENOID VALVE
SWO	STORM WATER OVERFLOW
TDP	TANK DRAIN PUMP
TMS	TANK MIXING SYSTEM
TNK	TANK
TP	TRANSFER PUMP
TPR	TRANSPORTER
TRAY	IMPINGEMENT TRAY
TVS	TRANSIENT VOLTAGE SUPPRESSOR
UP	UNLOADING PUMP
UPS	UNITERRUPTABLE POWER SUPPLY
V	VALVE
VFD	VARIABLE FREQUENCY DRIVE
VNTI	VENTURI
WAR	WET AIR RECEIVER
WB	WINDBOX
WG	WEIR GATE
WHB	WASTE HEAT BOILER
WNDG	WINDINGS
WSC	WET SCRUBBER

Section 7.2 - Parameter Abbreviations

Parameter Abbreviation			
Conductivity	MHO		
Concentration	CONC		
Current	AMP		
Flow Rate	FLW		
Kilovolts	KV		
Kilowatts	KW		
Level	LVL		
Megawatts	MW		
pH	pH		
Pressure	PSI		
Differential Pressure	PSID		
Temperature	TMP		
Differential Temperature	TMPD		
Position	POS		
Speed	SPD		
Torque	TRQ		
Turbidity	TRB		
Vibration	VIB		
Others			
Alarm	ALM	High and Low (applied to alarms or interlocks)	HH, H, L, LL
Average	AVG		
Bypass	BYP		
Backwash	BKW	Maintenance	MAINT
Building	BLDG	Modbus, ModbusPlus	MB, MBP
Command	CMD	Pushbutton	PB
Compute/Compensate	COMP	Remote	REM
Interlock	ILK	Residual	RSDL
Local	LOC	Reverse	REV
Lower	LWR	Runtime	RT
Fault, Failure	FLT	Setpoint	STPT
Feedback	FDBK	Upper	UPR
Forward	FWD		

Part V ControlLogix/Wonderware/PanelView Plus 6

SECTION 1 - INTRODUCTION

The following sections include standards for developing process control logic and graphics using Rockwell Software RSLogix5000, Wonderware Archestra IDE, and Rockwell Software FactoryTalk View.

SECTION 2 - WONDERWARE STANDARDS AND CONVENTIONS

Section 2.0 - Introduction

The following sections detail the required standards and provide development guidance for process screens and related components that collectively are the NEORS D Wonderware HMI Monitor and Control System (MCS). These screens allow plant operators to perform the required process control and monitoring functions from Area Control Stations (ACSs) located throughout the plant.

Section 2.1 - Wonderware ArchestrA Key Concepts

The ArchestrA product contains key concepts that need to be understood in order to plan, design, and implement an application. Some key concepts include DA Servers (supply data to client nodes), Alarm DB Logger Manager, Application Servers, Galaxy Repository, Historian, Information Server, and HMI clients.

At NEORS D there will be a SuiteLink Client instance for each PLC in the system (ControlLogix or PLC5/SLC500).

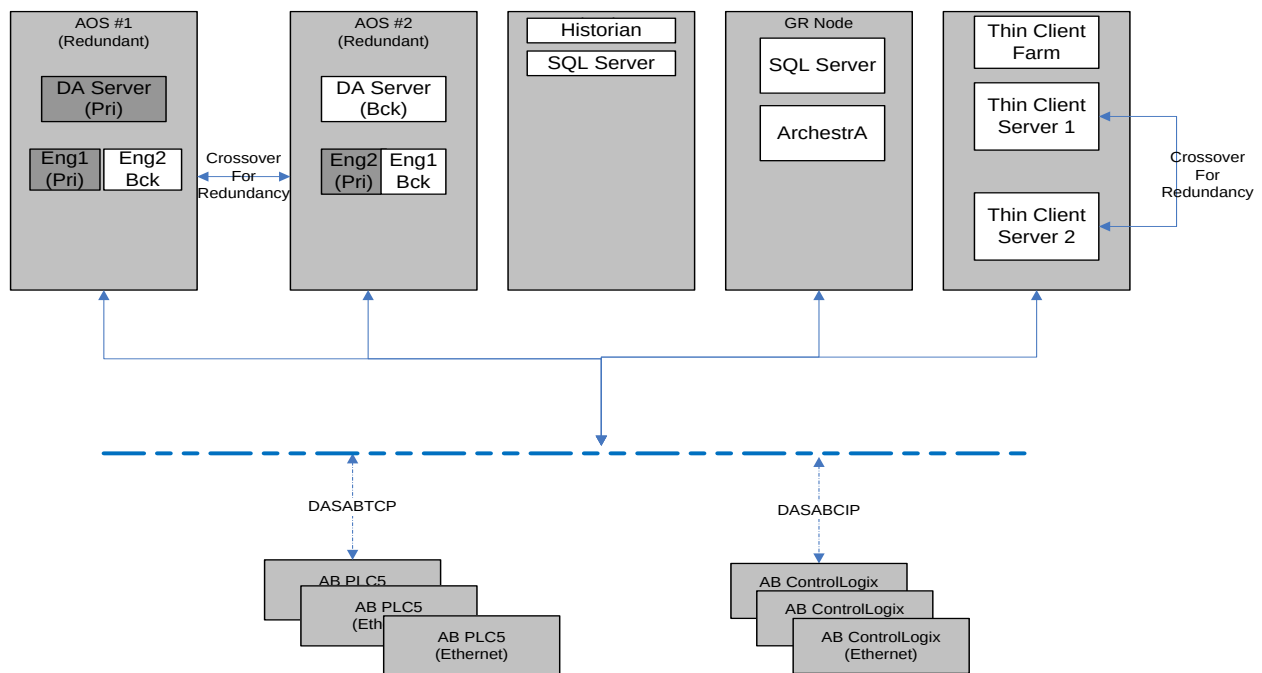
- For PLC5 or SLC500, the specific SuiteLink Client instances will contain a mapping conversion table that provides the link between standard object attributes and the PLC data registers. The DASABTCP IO Server is used.
- For ControlLogix, the SuiteLink will communicate via DASABCIP I/O server directly to the tag names in the processor without the need for the mapping conversion table or PLC5 SuiteLink Client instances. The DASABCIP IO Server is used.

In order to successfully connect a PLC to Wonderware, the DAServers must be set up to poll the PLC using the appropriate protocol (DASABTCP or DASABCIP), and the PLC must have a properly configured Suitelink instance within the NEORS D Galaxy.

ArchestrA objects run within engines that are hosted on Application Servers. The Application Servers are load sharing redundant servers (no less than two per site hosted in different physical locations for “fox-hole” redundancy) and are capable of completely running the system in the event of a server failure. InTouch Applications providing the runtime process screens are deployed to individual clients within the galaxy. The system runs in a Server-Client configuration where the Application Servers host the galaxy (ArchestrA database) and the clients display the information. At NEORS D most of the clients will be deployed as thin-client machines hosted on redundant servers.

Section 2.2 - Simplified Network Architecture

*network representation below is currently in development



System Features

Single Galaxy Repository Server

Redundant AOS Servers for each processing site

Redundant DA Servers for each processing site

Redundant Thin Client Servers for each processing site

Historian Store Forward (prevents data-loss by locally buffering data in the event the primary historian connection is lost)

Section 2.3 - Software

2.3.A - New Applications

All new applications are required to be developed using the latest available NEORS D provided galaxy CAB file (or equivalent). This export will contain all the currently available (released) standard library objects and InTouch application to support development activities.

This export will be re-created periodically as functional elements are added and/or enhanced. Additionally, other exports will be created “as required” in order to maintain an appropriate level of application consistency between the NEORS D master galaxy and any standalone in development copies.

The NEORS D Wonderware HMI is a managed InTouch application which has been developed using custom NEORS D developed library template objects. Refer to NEORS D Standard Object Library User Manual for details on the currently available object template library.

Note: No InTouch tags (placeholders) are to be used without NEORS D pre-approvals. All operator screens shall be constructed using NEORS D template objects and graphic symbols.

All new applications are required to be developed within software environments that use matching application software revisions, applied hot fixes, patches etc to those at NEORS D. Software developed using outdated revisions will not be accepted for import into the NEORS D galaxy.

Section 2.4 - Security Design

2.4.A - Platform / Application Security

- Authentication Mode = OS Group Based (security model)
- Configurable Intervals
 - Security Groups:
 - o 18_Opers
 - o 2798_Opers
 - o Admin
 - o Managers
 - o Default
 - Users and Roles:
 - o Administrator
 - o Default
 - o HMI Programmer
 - o 18_Opers
 - o 2798_Opers
 - o Facility_Managers
 - o Domain Programmers
 - o REF_Programmers
 - o Administrators
- User ID and Password Authentication = OS Group Based
- By default, setpoint changes are allowed by normal operator access. District operations/PC&A must determine and configure specific instances where set point editing is NOT standard procedure for operators.

2.4.B - ArchestrA Role – Default

- View only, no ArchestrA or InTouch permissions.
- Print displays
- Access level = 0
- General permissions = None
- Operational permissions = None

2.4.C - ArchestrA Role – 18_Opers

- No ArchestrA permissions.
- Able to perform basic controls within InTouch (turn pumps on/off, open/close valves, change from auto/man, ect.) and specific setpoints needed for operations.
- Only able to control equipment within specified areas (details to be provided by district/Cimlicity).
- Access level = 500
- General permissions = None
- Operational permissions:
 - 18_Opers
 - Can Acknowledge Alarms
 - Can Modify “Configure” Attributes
 - Can Modify “Operate” Attributes
 - Can Modify “Tune” Attributes

2.4.D - ArchestrA Role – 2798_Opers

- No ArchestrA permissions.
- Able to perform basic controls within InTouch (turn pumps on/off, open/close valves, change from auto/man, ect.) and specific setpoints needed for operations.
- Only able to control equipment within specified areas (details to be provided by district/Simplicity).
- Access level = 500
- General permissions = None
- Operational permissions:
 - 2798_Opers
 - Can Acknowledge Alarms
 - Can Modify “Configure” Attributes
 - Can Modify “Operate” Attributes
 - Can Modify “Tune” Attributes

2.4.E - ArchestrA Role – Facility_Managers

- No ArchestrA permissions.
- Able to perform basic controls within InTouch (turn pumps on/off, open/close valves, change from auto/man, ect.) as well as setpoints restricted to the operators.
- Access level = 1000
- General permissions = None
- Operational permissions:
 - 18_Opers
 - Can Acknowledge Alarms
 - Can Modify “Configure” Attributes
 - Can Modify “Operate” Attributes

- o Can Modify “Tune” Attributes

➤ 2798_Opers

- o Can Acknowledge Alarms
- o Can Modify “Configure” Attributes
- o Can Modify “Operate” Attributes
- o Can Modify “Tune” Attributes

2.4.F - ArchestrA Role – HMI Programmers/Domain Programmers/REF Programmers

- All permissions of Facility_Manager plus restricted ArchestrA permissions.
- Within ArchestrA will be able to derive new instances, create/edit windows, ect.
- No permission to edit/create templates.
- Access level = 9000
- General permissions:
 - IDE Permissions
 - o Can Start the IDE
 - o Importing and Exporting
 - Can Utilize GalaxyLoad/GalaxyDump
 - o General Configuration
 - Can Modify Deployed Instances
 - Can Disable Change Comments
 - Can Override Checkout
 - Can Upload from Runtime
 - o System Configuration
 - Can Create/Modify/Delete System Object Instances (Platforms and Engines)
 - Can Create/Modify/Delete Area Objects
 - o DeviceIntegration Objects
 - Can Create/Modify/Delete DeviceIntegration Object Instances
 - o Application Configuration
 - Can Create/Modify/Delete Application Object Instances
 - o Deployment Permissions
 - Can Deploy/Undeploy System Objects
 - Can Deploy/Undeploy Area Objects
 - Can Deploy/Undeploy Application Objects
 - Can Deploy/Undeploy DeviceIntegration Objects
 - Can Mark an Object as Undeployed
 - o Graphic Management Permissions
 - Can Create/Modify/Delete ViewApplications
 - Can Deploy/Undeploy ViewApplications

- SMC Permissions
 - Can Start the SMC
 - Can Start/Stop Engine/Platform
 - Can Write to GObject Attributes using ObjectViewer
- Operational permissions = All

2.4.G - ArchestrA Role – Administrator/Administrators

- Default Wonderware user with full control of ArchestrA and InTouch.
- Access level = 9999 (*unchangeable)
- General permissions = All
- Operational permissions = All

2.4.H - Common Functions (InTouch)

- *Inactivity Warning* – If someone is logged into the system for more than 50 minutes without any activity on the HMI node the system will warn the user of a pending Inactivity Automatic Logout.
- *Inactivity Timeout* – if someone is logged into the system for more than 60 minutes without any activity on the HMI node the system will automatically log the user off the system.
- Disable ALT, ESC and Windows keys if the currently logged in user is not an administrator

2.4.I - Electronic Records

- The InTouch wwalmdb database stores events and alarms with user information within SQL on the historian.
- The analog values are stored in the runtime database within SQL on the historian
- All InTouch event and alarm records are stamped with date and time (UTC).
- In Wonderware electronic signatures are based on a combination of an identification codes (User Name) and password.
- Preserving User Name uniqueness can be maintained assuming users are disabled and never deleted. The NEORS D Automation group manages this function with procedural controls.

SECTION 2.5 - COMMUNICATION DESIGN

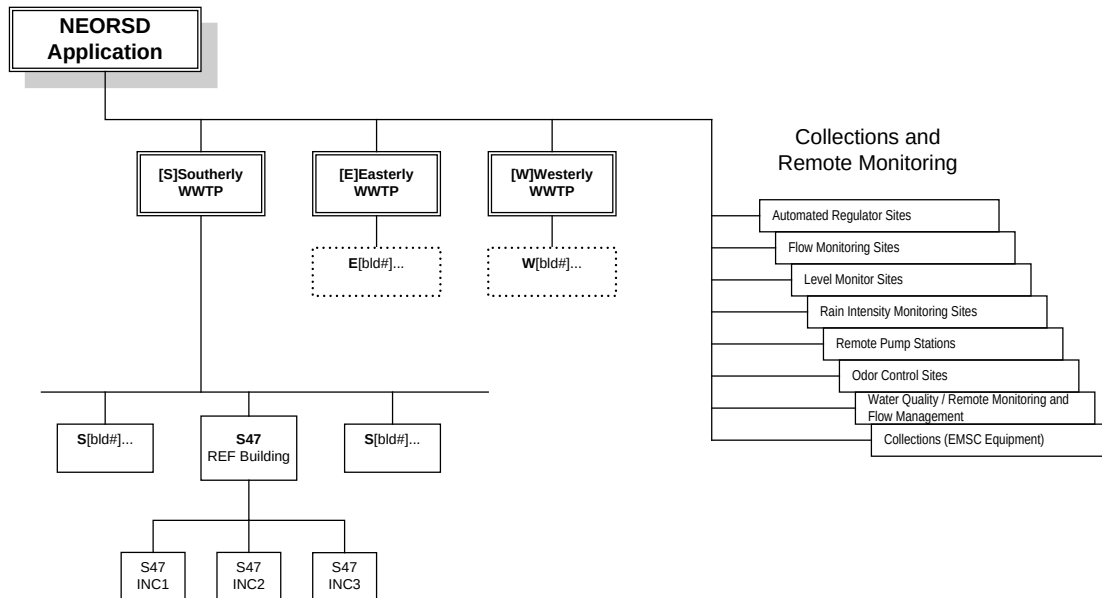
2.5.A - ArchestrA IDE

The Integrated Development Environment (IDE) provides the interface to the configuration aspects of the Application Server. From the IDE you manage templates, create object instances, deploy, un-deploy, and perform functions associated with the development and maintenance of the system.

The production Galaxy name is NEORS D_Production.

2.5.B - Model View

The NEORS D model view is currently under development but will incorporate a site => process location => equipment structure as indicated below:



*Note: For the WWTPs the building number [bld#] closely follows the process areas.

2.5.C - Managed InTouch Application

The NEORS D Wonderware system has a Managed InTouch Application. In this model the InTouch application is handled like an “object”. Derived “Instances” of this centralized InTouch application are assigned to clients within the ArchestrA framework and deployed. Template changes are automatically indicated within the “Instances” by a COTS supplied deployment symbol. Until re-deployed the original configuration will continue to run. Deployed objects are automatically loaded onto the clients, however, COTS software limitations may require manual restarts of the thin client InTouch application which will be performed by the ACP Thin Client Management Software.

2.5.D - Data Collection

The MCS system collects data directly from the PLCs in the field. The I/O Servers hosted on each Application Server communicate with the PLCs on a facility wide Ethernet fiber network.

2.5.E - Tag Naming Standards

The tag naming standards and conventions are detailed in section 1.9 of this document.

SECTION 2.6 - BASE TEMPLATE LIBRARY (BTL)

2.6.A - Introduction

The NEORS D Galaxy was created using the Wonderware provided quick-start library known as the North American Base Template Library or BTL. The BTL represents a collection of templates that enable three (3) common areas of functionality.

Linking an Application Object to a Device Integration Object

Configuring object lists about how the object is configured and where it exists in the Plant Model.

Configurable ability to persist changes to user writeable attributes of the application objects when undeploying and deploying the object. **Note: This feature uses XML stored locally on the AOS server and by default is not redundant.*

2.6.B - BTL Input Source Scripts

The BTL input source script operation

The BTL scripts auto populate the input sources of all instances when “---“ is found for the default attribute value by making use of the following data format:

SuitelinkClientName.Topic.Instances.Attribute. For this scripting functionality to work the object instance attribute name(s) found in the Wonderware tag database must have an identically named PLC instance.attribute name(s).

Communication between the BTL input source script and non-object oriented PLCs

The Allen-Bradley PLC5s do not have an object oriented tagname.attribute database as they are address mapped. Therefore, a conversion table is required and it exists within the Suitelink object. This conversion table provides the linkage between the Wonderware tag database object instance attribute(s) and the PLC5 mapping address (i.e. N80:20/1). In the future PLC5s will be replaced by ControlLogix PLCs which have an object oriented tagname.attribute database eliminating the need for this conversion table as they will talk directly to PLC AOIs or UDTs.

The BTL input source script and unused attributes on common object library templates

The BTL script that auto populates the attribute input sources is persistent and continues (every 30 sec) to try and locate a valid address posting a warning message into the logger for each failure. Normally this is desired but what if you don’t care about a specific attribute because it is not being used by the instance? For example an overload alarm is provided in the standard library object template for a discrete motor but does not exist in a specific instance.

The solution involves the use of a Boolean Placeholder UDA which is inherited by all templates and object instances in the Galaxy and “Me.Placeholder” entered for the attribute value. The BTL input source script skips over “Me.Placeholder” when it is found and its internal source mapping back to the UDA provides a valid connection target. This solution provides us with a dummy placeholder for the unused attribute value that also removes the point from the I/O scan count.

*Note: It is required that all unused attributes within each object instance use “Me.Placeholder” to remove these points from the I/O scan counts.

2.6.C - BTL Script Locations

The BTL scripts and UDAs are found on the “m” and “a” levels of the derived templates. These are developed and maintained by Wonderware. After the BTL levels there is a separate template created for development in which all other templates are derived. These templates will have the prefix of NEORS to clearly show they are created and maintained by the District. This creates a centralized location for development that needs to be cascaded to all of the derived templates of this type. See the example below for a visualization of the derivation of a template:



Note: Developers must avoid making any modifications to these vendor developed and supported templates and/or scripts. **ANY** changes made to the application **MUST** be completely documented and preserved such that they can be readily re-deployed should the next revision to the BTLs be installed which likely would overwrite the modifications.

2.6.D - Data Logging Deadband

The templates are scripted to record or not record data with a deadband based upon the Engineering or Operational Unit Range. The following lists the ranges and the deadband required to record a change to the historian:

Range < 1	Value Deadband = 0.0001
1 <= Range < 10	Value Deadband = 0.001
10 <= Range < 100	Value Deadband = 0.01
100 <= Range < 1000	Value Deadband = 0.1
Range >= 1000	Value Deadband =1

The script writes the deadband to the attribute.ValueDeadband attribute under the history settings. This attribute must remain unlocked on the template to allow the script to overwrite the .ValueDeadband attribute.

SECTION 2.7 - PLATFORM TEMPLATES

Each Platform Template is stored in the PlatformTemplates toolset. There are two toolsets that will be used to derive all instances: NEORS and PlatformTemplates.

2.7.A – AlarmSummary

Description

The Alarm Summary provides the AlarmSummary Query and Alarm Footer Query. The query by default shows all of the alarms in the system but has custom filtering to allow the user to see a number of different alarms and events.

Functional Details

- All alarming is handled by the ArchestrA System Platform Alarm Engine.
- Hosts the alarm summary page and footer
- Functionality redundantly hosted between AOS node pairs.
- Drop down box used to select between current alarms, historical alarms, events, alarm state, and priority.
- String input box used to select the group main area.
- A separate alarm query for all system alarms.

Alarm Priorities

- Priority 1: Critical / High Importance
 - Health and Human Safety Alarms (Chlorine High Level, Explosive Gas High Level, etc.)
- Priority 2 - 500: Major / Medium Importance
 - Permit violations ("High-High" and "Low-Low" levels) and catastrophic machine failures.
- Priority 501 - 750: Minor / Low Importance
 - Process variable excursions ("high" and "low" levels), non-catastrophic machine failures and computer network failures.
- Priority 751 - 999
 - Potential future alarm level

Alarm Configuration

Alarms of different priorities are displayed on alarm summary pages using different colors to aid in their identification. Color configuration for alarms is shown below.

Alarm Priority	Alarm Level	Unacknowledged Alarms		Acknowledged Alarms + Flash Unack Alarms		Unack-Return Alarms	
		Text/ Foreground	Back-ground	Text/ Foreground	Back-ground	Text/ Foreground	Back-ground
1	High	White	Red	Red	White	White	Gray
2-500	Med	Black	Yellow	Yellow	Black	White	Gray
501-750	Low	White	Blue	Blue	White	White	Gray
751-999	*	White	Green	Green	White	White	Gray

*Note: 751 to 999 is being reserved for potential future development

Common Alarming Features

- Alarm Indications
 - o Active alarms that are unacknowledged will blink with the alarm priority color (Flash Unack Alarms)
 - o Active alarms that are acknowledged will stop blinking when acknowledged.
 - o Inactive alarms that are unacknowledged remain in the alarm summary queue until cleared by acknowledgement.

Graphics

- AlarmFooter
 - o Displays all the current alarms in the system. This graphic is also called:
 - a. AlarmFooter_Easterly
 - b. AlarmFooter_Southerly
 - c. AlarmFooter_Westerly

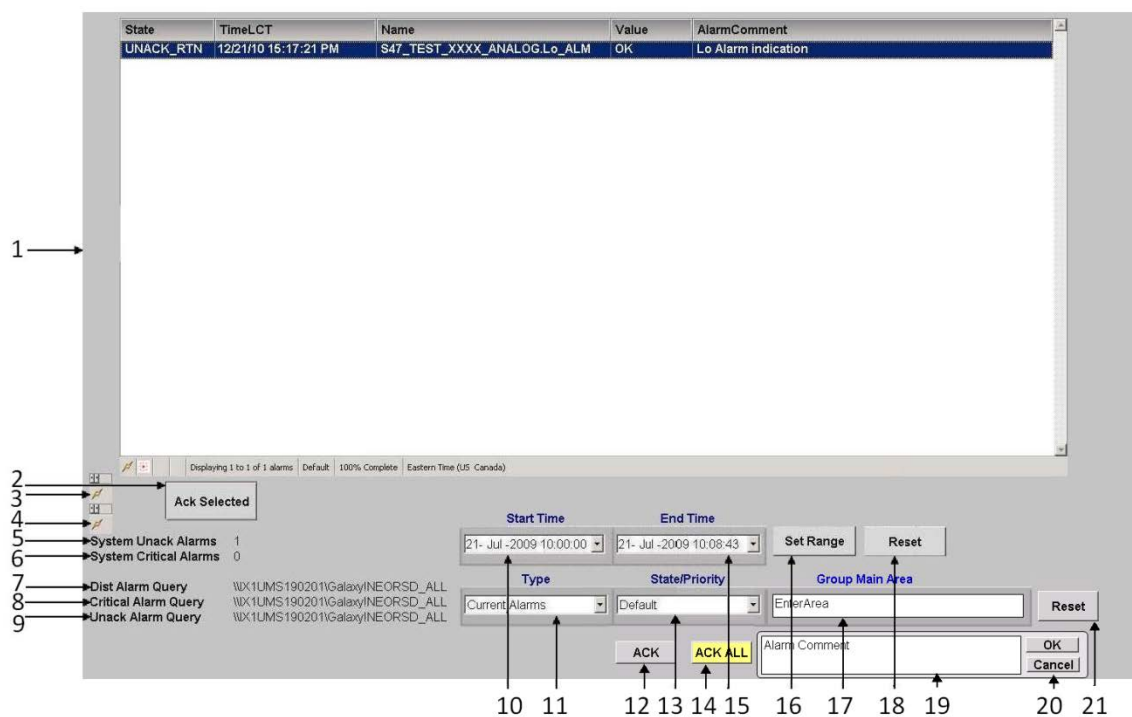
State	TimeLCT	Name	Value	AlarmComment
ACK	12/21/10 13:49:55 PM	S47_TEST_XXXX_ANALOG...	ALARM	Hi Alarm indication
UNACK	12/21/10 13:47:39 PM	S47_TEST_XXXX_ANALOG...	ALARM	Lo Alarm indication

Displaying 1 to 2 of 2 alarms | Default | 100% Complete | Eastern Time (US / Canada)

1

Graphic Number	Design Element	
	Function	Description
1	FooterAlarmQuery	This graphic displays all of the alarms, sorted by the time of the alarms. The column details of this section are State, TimeLCT, Name, Value, AlarmComment, and Priority (thru alarm color).

- Alarm Summary
 - Allows the user to see the Current Alarms/Events as well as Historical Alarms/Events. The user may acknowledge a select or all alarms and add an alarm comment. Filtering is also available to allow the user to sort by state, priority, or area. Below is a screenshot of the AlarmSummary with a description of each of the functions.
 - This graphic is also called:
 - d. AlarmSummary_Easterly
 - e. AlarmSummary_Southerly
 - f. AlarmSummary_Westerly



Graphic Number	Design Element	
	Function	Description
1	DistributedAlarmQuery	This graphic displays all the current alarms.
2	Ack Selected Button	This graphic button acknowledges the selected alarm from the DistributedAlarmQuery. The user must be logged in to be able to acknowledge an alarm.
3	UnackAlarm	This graphic has a permanent query for only unacknowledged alarms and is used to populate the System Unack Alarms output. This graphic is only visible to users with administrative privileges.
4	CriticalAlarm	This graphic has a permanent query for only priority one alarms and is used to populate the System Critical Alarms output. This graphic is only visible to users with administrative privileges.
5	System Unack Alarms Number	This graphic displays the number of current System Unacknowledged Alarms populated by the UnackAlarm query.
6	System Critical Alarms Number	This graphic displays the number of current System Critical Alarms populated by the CriticalAlarm Query.
7	Dist Alarm Query	This string is populated with the server node that is providing the data for the DistributedAlarmQuery. This graphic is only visible to users with administrative privileges.
8	Critical Alarm Query	This string is populated with the server node that is providing the data for the CriticalAlarm. This graphic is only visible to users with administrative privileges.
9	Unack Alarm Query	This string is populated with the server node that is providing the data for the UnackAlarm. This graphic is only visible to users with administrative privileges.
10	Start Time	This graphic displays a box in which the Start Time of a search can be selected from the DistributedAlarmQuery. This option is only available for historical alarms.
11	Type	This graphic displays the Type of the selected alarm from the DistributedAlarmQuery.
12	ACK Button	This graphic button allows the user to acknowledge a select alarm. After this button is pushed, but before the alarm is acknowledged, the user will be prompted to enter an (optional) alarm comment.
13	State_Priority	This graphic displays the State or Priority of the selected alarm from the DistributedAlarmQuery. This is only visible when Group Main Areas is equal to ALL ALARMS.
14	ACK ALL Button	This graphic button allows the user to acknowledge all unacknowledged alarms. After this button is pushed, but before the alarms are acknowledged, the user will be prompted to enter an (optional) alarm comment.
15	End Time	This graphic displays a box in which the End Time of a search can be selected from the DistributedAlarmQuery. This option is only available for historical alarms.
16	Set Range	This graphic button allows the user to set the Range of Start and End Time and when pressed, the DistributedAlarmQuery will display alarms from the time range. This option is only available for historical alarms.
17	Group Main Area	This graphic alarm filter allows the user to input the name of an Archestra area to see that area's alarms. This is only visible when State/Priority is equal to Default.
18	Reset Time Range	This graphic button resets the values in the Start Time and End Time boxes. This option is only available for historical alarms.

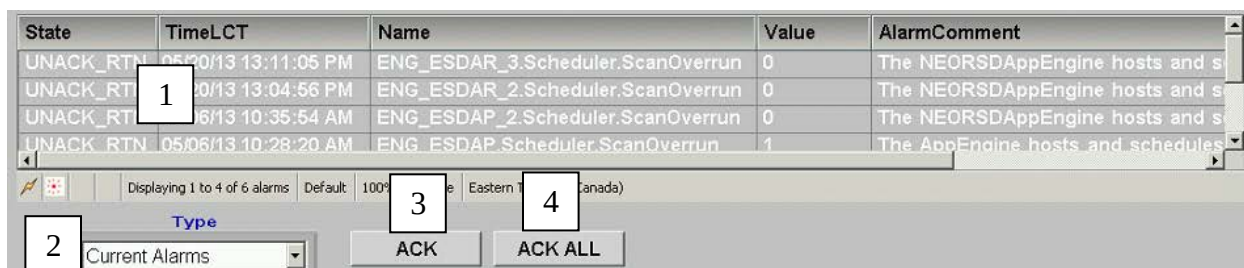
Graphic Number	Design Element	
	Function	Description
19	Alarm Comment	This string input is where the user may enter an alarm comment. Click the area, enter the alarm comment, and hit enter. At this point you may OK the acknowledge alarm with comment or Cancel it. If the alarm comment is left blank, the current alarm comment in the alarm summary will remain and the alarm(s) will be acknowledged.
20	Alarm Comment Options	These graphic buttons allow the user to either OK or Cancel the Acknowledge alarm operation.
21	Reset Filtering	This graphic button resets the area filtering back to the default. This is only visible when filtering by area.

- AlarmScreamer
 - o Popup that reopens/positions itself over every screen in the plant to notify operators of the highest priority alarms that require immediate action.
 - o Naming Format: AlarmScreamer_plant, where plant is Easterly, Westerly, Southerly, etc.

ALARM_SCREAMER_EASTERLY				
State	TimeLCT	Name	Value	AlarmComment
ACK	05/24/13 16:06:05 PM	TestTag	100	
ACK_RTN	05/24/13 16:06:05 PM	TestTag	100	
UNACK	05/24/13 16:06:05 PM	TestTag	100	

Graphic Number	Design Element	
	Function	Description
1	ScreamerAlarmQuery	This graphic displays all of the screamer alarms, sorted by the time of the alarms. The column details of this section are State, TimeLCT, Name, Value, AlarmComment, and Priority (thru alarm color).

- Alarm Summary_System
 - o Displays all the current system alarms in the system. This graphic is also called:
 - a. Alarm Summary_Easterly_System
 - b. Alarm Summary_Southerly_System
 - c. Alarm Summary_Westerly_System



Graphic Number	Design Element	
	Function	Description
1	System Alarm Query	This graphic displays all of the system alarms, sorted by the time of the alarms. The column details of this section are State, TimeLCT, Name, Value, Alarm Comment, and Priority (thru alarm color).
2	Type	This graphic displays the Type of the selected alarm from the Distributed Alarm Query.
3	ACK Button	This graphic button allows the user to acknowledge a select alarm..
4	ACK ALL Button	This graphic button allows the user to acknowledge all unacknowledged alarms.

Instances

- Alarm Summary

2.7.B – EngineForAlmLogService

Description

EngineForAlarmLogService activates and disables the Alarm Logging Service on each AOS node and prevents both Alarm Loggers from running simultaneously. This is necessary to make the alarm logging redundant and prevents historical alarms from being lost.

Functional Details

- Activates the redundant alarm logging engine on the backup AOS platform when a failover event occurs. This script starts the alarm logging engine because there is not any support in Server 2008 for this to run as a service.
- Based on location, the engine name in the Engine UDA must be updated.

General

Design Element	VALUE
Engine startup type	Auto
Engine Restart	Checked
Scan period	1000 ms
Enable storage to historian	Unchecked
Maximum time for scripts to execute	1000 ms
Maximum asynchronous thread count	5
Checkpoint period	0 ms
Checkpoint directory location	C:\Checkpoint
Alarm throttle limit	2000 alarms/s
Statistics average period	10000 ms
Maximum queue size	16 MB
Engine failure timeout	10000 ms
Maximum number of consecutive data notification failures allowed	0

Redundancy

Design Element	VALUE
Enable redundancy	Unchecked

R/W Interrupts

Design Element	VALUE
Number of read/write interrupts	5
Enable standard interrupts	Unchecked

Attributes

Attribute	DATA TYPE	DESCRIPTION
Almdb_setservice	Boolean	Turns the Alarm Logging Service on through the setservice script
AlmDBLogRunning	Boolean	Checks to see on which node the Alarm Logger is running
Engine	String	Provides engine name for setservice script, based on location engine name must be changed

Scripts

Script	EXECUTION TYPE	DESCRIPTION
ALMDB	Execute	Restarts the engine when the platform changes
onscan	Execute	Triggers the setservice script when the object is on scan
Setservice	Execute	Starts and Stops the Alarm DB Logger depending on which platform the object is hosted
Setservice	Shutdown	Kills the Logger Service when the object is shutdown

Graphics

- DBLoggerConnection
 - o The DBLoggerConnection graphic displays a constant string of 'DB Logger Status' followed by a dynamic string value that says 'Running' in black when the DBLogger is running and has a connection with the PLC and 'Stopped' in black when it is not.



Graphic Number	Design Element	
	Function	Description
1	DB Logger Status	This graphic string displays the status of the DB Logger. The string displays Running and Stopped to show when the DB Logger is logging data.

Instances

- EngineForAlmLogService_E_AOS1
- EngineForAlmLogService_E_AOS2
- EngineForAlmLogService_S_AOS1
- EngineForAlmLogService_S_AOS2
- EngineForAlmLogService_W_AOS1
- EngineForAlmLogService_W_AOS2

2.7.C - Historian

Description

The Historian object is used to trigger alarms based upon the historian's condition.

Functional Details

- Creates alarms in the Galaxy if there are issues with the Historian that are not generated by default within the Galaxy. Examples include Critical Alarms (if more than x alarms generated), DataAcqRate, SysWarning, and SysFatalErrors.

Attributes

Attribute	Data Type	DESCRIPTION	ALARM PRIORITY
SysCritErrCnt	Integer	Total critical errors since startup. If above the value of 3 an alarm will occur.	500
SysDataAcqOverallItemsPerSec	Integer	Items per second received from the historian. If the value drops below 9 an alarm will occur.	500
SysErrErrCnt	Integer	Total non fatal errors since startup. If the value goes about 6 an alarm will occur.	500
SysFatalErrCnt	Integer	Total fatal errors since startup. If the value goes about 1 an alarm will occur.	500
SysWarnErrCnt	Integer	Total warnings since startup. If the value goes about 26 an alarm will occur.	750

Instances

- Southerly_Historian
- Westerly_Historian
- Easterly_Historian

2.7.D - MenuBar

Description

The Menu Bar provides a drop down list of windows from tabs based upon the UDA values entered on the instance.

Functional Details

- The tab name is configured via an ArchestrA UDA. A string may be entered in the Tab##Caption UDA. This string will display text on the ## tab. (## may be 1-12). The Tab Caption controls the tab visibility.
- The tab navigation is also configured via a UDA. An array of strings of up to 15 may be entered in the Tab##Menu UDA. For navigation to work each string must be an InTouch window name.
- The home button will navigate to the respective Plant Overview screen depending on Node.
- The Perm_Value display will be green if true, red if false.
- Tab 12 is used for links to diagnostic screens, and is only visible to administrators.

Attributes

Attribute	Data Type	DESCRIPTION
Tab01Caption	String	String is caption on navigation tab 01.
Tab01Menu	String	String array are navigation links for tab 01.
Tab02Caption	String	String is caption on navigation tab 02.
Tab02Menu	String	String array are navigation links for tab 02.
Tab03Caption	String	String is caption on navigation tab 03.
Tab03Menu	String	String array are navigation links for tab 03.
Tab04Caption	String	String is caption on navigation tab 04.
Tab04Menu	String	String array are navigation links for tab 04.
Tab05Caption	String	String is caption on navigation tab 05.
Tab05Menu	String	String array are navigation links for tab 05.
Tab06Caption	String	String is caption on navigation tab 06.
Tab06Menu	String	String array are navigation links for tab 06.
Tab07Caption	String	String is caption on navigation tab 07.
Tab07Menu	String	String array are navigation links for tab 07.
Tab08Caption	String	String is caption on navigation tab 08.
Tab08Menu	String	String array are navigation links for tab 08.
Tab09Caption	String	String is caption on navigation tab 09.
Tab09Menu	String	String array are navigation links for tab 09.
Tab10Caption	String	String is caption on navigation tab 10.
Tab10Menu	String	String array are navigation links for tab 10.
Tab11Caption	String	String is caption on navigation tab 11.

Attribute	Data Type	DESCRIPTION
Tab11Menu	String	String array are navigation links for tab 11.
Tab12Caption	String	String is caption on navigation tab 12.
Tab12Menu	String	String array are navigation links for tab 12.

Graphics

- Menu_Bar: Allows the user to access custom navigation. When a tab is selected a dropdown box allows access to the navigation. A home button and perm_value display are included.



Graphic Number	Design Element	
	Function	Description
1	Tab (1-12)	Theses tabs can be configured in ArchestrA via UDAs to provide custom navigation.
2	Home Button	This graphical button will navigate the user to the Plant_Overview for each NEORS location.
3	Perm_Value Light	This graphical light will display green if the InTouch Perm_Value is true, red if false.

Instances

- Southerly_Menu
- Westerly_Menu
- Easterly_Menu

2.7.E - \$NEORSDAOS

Description

The \$NEORSDAOS represents a server in the automation application with redundancy and hosts engines, areas, and instances.

Functional Details

- Additional layer from other platforms
- Provides a template for redundant AOS platforms
- The Alarm Provider which creates and manages alarms.
- History enabled to ensure all platform data is properly stored
- Store Forward enabled to locally store data to ensure data is never lost in the event of a connection issue with the Historian

General

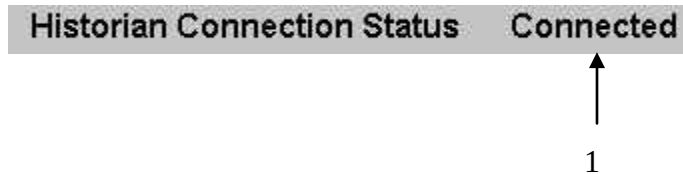
Design Element	VALUE
Network address	<blank>
Historian Store Forward Directory	C:\StoreForward
Minimum RAM	1024 MB
Statistics Average Period	10000 ms
Enable InTouch alarm provider	Checked
Redundancy message channel port:	30001
Redundancy primary channel port:	30000
Register using "Galaxy..."	Unchecked
Alarm Areas	<blank>
Message timeout	120000 ms
NMX heartbeat period	2000 ms
Cons number of missed NMX	3
Message exchange port	5026

Engine

Design Element	VALUE
Engine startup type	Auto
Scan period	1000 ms
History – Enable storage to historian	Checked
History – Enable Tag Hierarchy	Checked
History – Historian	---
History –Store forward deletion threshold	100 MB
History – Store forward minimum duration	0 s
History – Forwarding chunk size	1024 Byters
History – Forwarding delay	250 ms
History – Buffer count	128
Scripts – Maximum time for scripts to execute	1000 ms
Scripts - Maximum asynchronous thread count	5 threads
Checkpoint period	1000 ms
Checkpoint directory location	C:\Checkpoint
Alarm throttle limit	2000 alarms/s
Statistics average period	10000 ms
Maximum input queue size	16 MB
Engine failure timeout	10000 ms
Maximum number of consecutive data notification failures allowed	0

Graphics

- HistorianConnection
 - o The HistorianConnection graphic displays a constant string of 'Historian Connection Status' followed by a dynamic string value that says 'Connected' in black when the Historian has a connection with the PLC and 'Disconnected' in red when the connection has been lost.



Graphic Number	Design Element	
	Function	Description
1	Historian Connection Status	This graphic display indicates the connectivity of the Historian showing either Connected in black and Disconnected in red with the connection has been lost.

Instances

- ESDAP
- ESDAR
- SSDAP
- SSDAR
- WSDAP
- WSDAR

2.7.F - NEORS DAppEngine

Description

The NEORS DAppEngine hosts and schedules execution of Application Objects, Areas, and Device Integration Objects.

Functional Details

- Provides redundancy between AOS platforms to ensure robust data acquisition
- Additional layer between the derived engines and \$aAppEngine
- Supports flexibility of design if a common script/attribute/UDA needs created and is common to all engines
- Addition of this layer supports manufacturer best practices and prevents need to alter BTLs
- History enabled to ensure all data is properly stored

General

Design Element	VALUE
Engine startup type	Auto
Engine Restart	Unchecked
Scan period	1000 ms
History – Enable storage to historian	Checked
History – Enable Tag Hierarchy	Checked
History – Historian	---
History – Store forward deletion threshold	100 MB
History – Store forward minimum duration	0 s
History – Forwarding chunk size	1024 Bytes
History – Forwarding delay	250 ms
History – Buffer count	128
History – Enable Late Data	Unchecked
Scripts – Maximum time for scripts to execute	1000 ms
Scripts – Maximum asynchronous thread count	5 threads
Checkpoint period	20000 ms
Checkpoint directory location	C:\Checkpoint
Alarm throttle limit	2000 alarms/s
Statistics average period	10000 ms
Maximum input queue size	16 MB
Engine failure timeout	10000 ms

Design Element	VALUE
Maximum number of consecutive data notification failures allowed	0

Redundancy

Design Element	VALUE
Enable redundancy	Checked
Forced failover timeout	90000 ms
Maximum checkpoint deltas buffered	0
Maximum alarm state changes buffered	0
Standby engine heartbeat period	1000 ms
Active engine heartbeat period	1000 ms
Maximum consecutive heartbeats missed from Active engine	5
Maximum consecutive heartbeats missed from Standby Engine	5
Maximum time to maintain good quality after failure	120000
Maximum time to discover partner	15000
Restart engine process when transitioning from Active to Standby	checked

R/W Interrupts

Design Element	VALUE
Number of read/write interrupts	5
Enable standard interrupts	Unchecked

Instances

- ENG_ESDAP
- ENG_ESDAR
- ENG_SSDAP
- ENG_SSDAR
- ENG_WSDAP
- ENG_WSDAR

2.7.G - \$NEORS DArea Lower

Description

The Area represents a plant area and allows grouping of objects for modeling and alarm reporting. The I/O BTL script by default searches the area for a Suitelink client for a connection to the DAServer. This area looks at the containing area for the server name and topic for data acquisition, which allows for areas within areas that do not require a separate DDESuitelinkClient instance. In order for this to work, the top area must be derived from NEORS DArea_Top and that area must contain a SuitelinkClient instance. Every area contained within that Top Area will “look up” to the containing area for its I/O. The area derived from NEORS DArea_Top is NEORS DArea_Lower.

Functional Details

- Additional layer between the derived engines and \$aArea.
- Supports flexibility of design if a common script/attribute/UDA needs created and is common to all areas
- Allows for entire area’s alarms to be disabled

Instances

- Instance name should match the PLC name, with a prefix that reflects the NEORS D plant:
 - o Site designators are listed in Part II, Section 1.5.I of this document. A sample listing is repeated below for convenience.
 - o Note: Southerly instances have no prefix as it plays host to the WW galaxy).

E	Control points within or from Easterly WWTC
W	Control points within or from Westerly WWTC
A	Automated Regulator sites
F	Flow Monitoring sites
L	Level Monitoring sites
R	Rain Intensity monitoring sites
P	Remote Pump Stations
O	Odor Control sites
U	Water Quality / Industrial Surveillance remote monitoring sites and Flow Management
C	Collection system control facilities, however, its ongoing use should be limited to points specifically associated with EMSC building equipment.

2.7.H - \$NEORSArea_Top

Description

The Area represents a plant area and allows grouping of objects for modeling and alarm reporting. Through the BTL I/O Scripting, this area will look for a Suitelink Instance contained within the area for its data. If other areas are contained within this area instance they should be derived from \$NEORSArea_Lower and these areas will “look up” to the top area instance for their data.

Functional Details

- Additional layer between the derived engines and \$aArea.
- Supports flexibility of design if a common script/attribute/UDA needs to be created and is common to all areas
- Allows for entire area’s alarms to be disabled
- Addition of this layer supports manufacturer best practices and prevents need to alter BTLs

Instances

- Instance name should match the PLC name, with a prefix that reflects the NEORS plant:
 - Site designators are listed in Part II, Section 1.5.I of this document. A sample listing is repeated below for convenience.
 - Note: Southerly instances have no prefix as it plays host to the WW galaxy).

E	Control points within or from Easterly WWTC
W	Control points within or from Westerly WWTC
A	Automated Regulator sites
F	Flow Monitoring sites
L	Level Monitoring sites
R	Rain Intensity monitoring sites
P	Remote Pump Stations
O	Odor Control sites
U	Water Quality / Industrial Surveillance remote monitoring sites and Flow Management
C	Collection system control facilities, however, its ongoing use should be limited to points specifically associated with EMSC building equipment.

2.7.I - \$NEORS DClient

Description

The NEORS DWinPlatform_Client represents a client node in the application that is not a thin client.

Functional Details

- Provides a template for each client node in the application that is not a thin client
- Removes the unnecessary functionality for a client included in the AOS and GR Platforms
- Allows for data on a client.

General

Design Element	VALUE
Network address	<blank>
History store forward directory:	<blank>
Minimum RAM	1024 MB
Statistics Average Period	10000 ms
Enable storage to historian	unchecked
Redundancy – Redundancy message channel IP address:	<blank>
Redundancy – Redundancy message channel port	30001
Redundancy – Redundancy primary channel port	30000
Message Exchange – Message timeout	30000 ms
Message Exchange – NMX heartbeat period	2000 ms
Message Exchange – Consecutive number of missed NMX heartbeats allowed	3
Message Exchange – Message exchange port	5026

Engine

Design Element	VALUE
Engine startup type	Auto
Restart the engine when it fails	<blank>
Scan period	1000 ms
Enable storage to historian	unchecked

Design Element	VALUE
Scripts – Maximum time for scripts to execute	1000 ms
Scripts - Maximum asynchronous thread count	5 threads
Checkpoint period	1000 ms
Checkpoint directory location	C:\Checkpoint
Alarm throttle limit	2000 alarms/s
Statistics average period	10000 ms
Maximum input queue size	16 MB
Engine failure timeout	10000 ms
Maximum number of consecutive data notification failures allowed	0

Instances

- ESTSP
- ESTSR
- WSTSP
- WTSR
- SSTSP
- SSTSR

2.7.J - \$NEORSDDDESuiteLinkClient

Description

The \$NEORSDDDESuiteLinkClient provides connectivity to DDE or SuiteLink I/O servers.

Functional Details

- Additional layer between the derived templates and \$aDDESuiteLinkClient.
- Supports flexibility of design if a common script/attribute/UDA needs created and is common to all areas
- Location of ServerFailOver script which is common to all areas and supports redundant AOS platforms (switches active DA server to backup platform)
- Addition of this layer supports manufacturer best practices and prevents need to alter BTLs

General

Design Element	VALUE
Detect connection alarm	Checked

Design Element	VALUE
Priority	500
Communication protocol	SuiteLink

Attributes

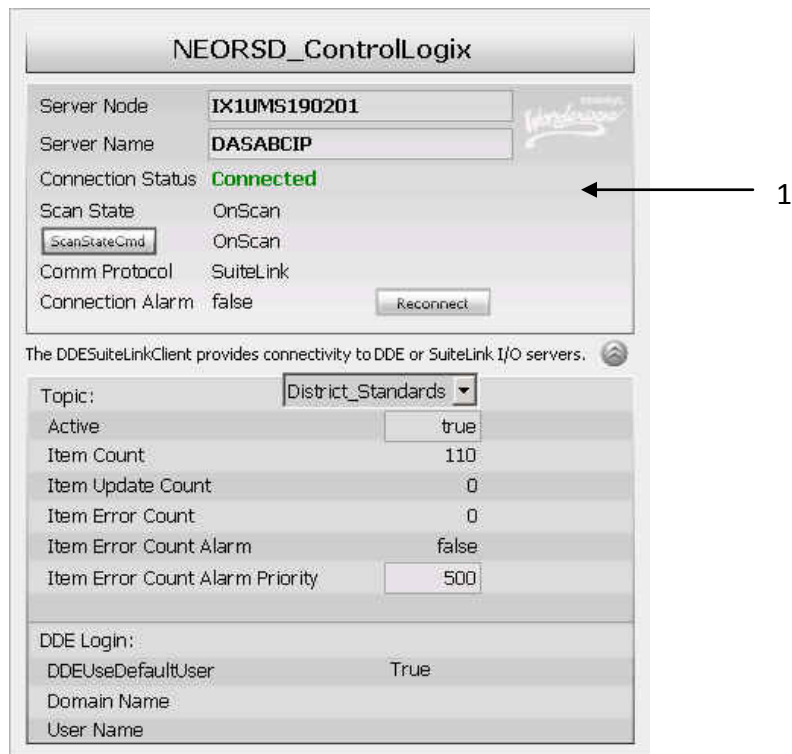
Attribute	Data Type	DESCRIPTION
BackupServer	String	Name of Backup AOS node used by ServerFailOver script
Connection_Attempts	Integer	Number of attempts made by the Suitelink Client before failing over to the backup
Connection_Retries	Integer	Number of attempts to reconnect to the initial platform before declaring a disconnect and failing over to the backup
PrimaryServer	String	Name of Primary AOS node used by ServerFailOver script

Scripts

Script	Execution Type	DESCRIPTION
ReturnToPrimary	Execute	Attempts to reconnect to the primary node every 30 minutes when gathering data through the backup node
ServerFailOver	Execute	Connects to the backup node when connection to the primary DAServer is lost

Graphics

- Display
 - This Display is directly taken from the default Wonderware graphic toolbox. The object was created from DDESuiteLinkClientDisplay. One script and custom property were added for the selection of the topic name through a drop down list selection. This object describes the server hosting, the client, the connection state, the scan state, and topic information.
- Display – Alterations
 - The following alterations were made to the display in order to custom design the display to allow a drop down topic list, which is not in the default configuration.



Graphic Number	Design Element	
	Function	Description
1	SuitelinkTopic	Drop down for the selection of topic name.

- Node_Display
 - o This Node_Display Graphic shows the tagname of the object and the node that it is connected to.



Graphic Number	Design Element	
	Function	Description
1	Tagname	This displays the tagname of the object.
2	Node	This string displays the ServerNode that the object is hosted on.

Instances

When naming the instances make the name match the name of the associated PLC followed by “_SL”. For example if the PLC is named “SH” (solids handling) the contained SuiteLink instance should be named “SH_SL”.

2.7.K - \$NEORSDDDESuiteLinkClient_HIS

Description

The \$NEORSDDDESuiteLinkClient_HIS provides connectivity to the SuiteLink I/O server on the Historian. A separate Suitelink template is needed because the Historian does not have redundancy.

Functional Details

- Provides connection to the historian to monitor the historian’s status and alarms
- Script included which reconnects to historian periodically if connection is lost

General

Design Element	VALUE
Server name	aahIOSvrSvc
Detect connection alarm	Checked
Priority	500
Communication protocol	SuiteLink

Topic

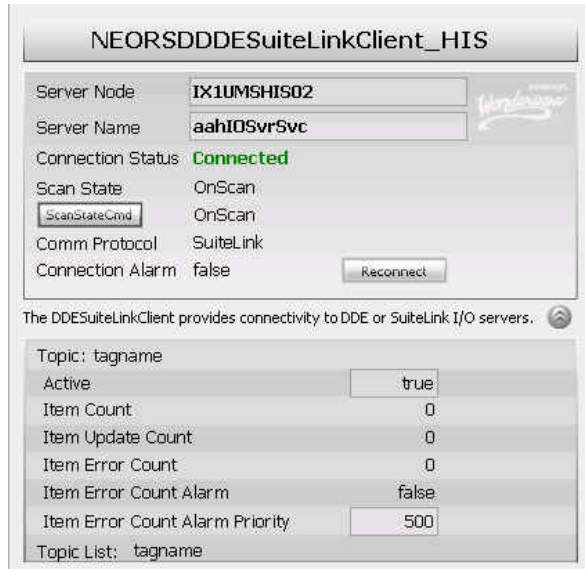
Topic	SCAN MODE
Tagname	ActiveAll

Scripts

Script	Execution Type	DESCRIPTION
Reconnect	Execute	Reconnects to Historian after 5 minutes

Graphics

- Display
 - This Display is directly taken from the default Wonderware graphic toolbox. The object was created from DDESuiteLinkClientDisplay. This object describes the server hosting, the client, the connection state, the scan state, and topic information.



NEORSDDDESuiteLinkClient_HIS

Server Node: IX1UMSHIS02

Server Name: aahIOSvrSvc

Connection Status: **Connected**

Scan State: OnScan

Comm Protocol: SuiteLink

Connection Alarm: false

Reconnect

The DDESuiteLinkClient provides connectivity to DDE or SuiteLink I/O servers.

Topic: tagname

Active: true

Item Count: 0

Item Update Count: 0

Item Error Count: 0

Item Error Count Alarm: false

Item Error Count Alarm Priority: 500

Topic List: tagname

Instances

- NEORSDDDESuiteLinkClient_HIS_South
- NEORSDDDESuiteLinkClient_HIS_West
- NEORSDDDESuiteLinkClient_HIS_East

2.7.L - \$NEORS DGR

Description

The NEORS DGR represents a Galaxy Repository platform node in the application.

Functional Details

- Provides a template for each GR Platform in the system.
- Unneeded functionally such as enabling history and redundancy are not enabled allowing for greater flexibility within the templates
- Designed so if connection to GRNode is lost the system will still properly operate

General

Design Element	VALUE
Minimum Ram	1024 MB
Statistics average period	10000 ms
Redundancy – Redundancy message channel port	30001
Redundancy – Redundancy primary channel port	30000
Message Exchange – Message timeout	120000 ms
Message Exchange – NMX heartbeat period	2000 ms
Message Exchange – Consecutive number of missed NMX heartbeats allowed	3
Message Exchange – Message exchange port	5026

Engine

Design Element	VALUE
Engine startup type	Auto
Restart the engine when it fails	checked
Scan period	1000 ms
Scripts – Maximum time for scripts to execute	1000 ms
Scripts - Maximum asynchronous thread count	5 threads
Checkpoint period	0 ms
Alarm throttle limit	2000 alarms/s
Statistics average period	10000 ms

Design Element	VALUE
Maximum input queue size	16 MB
Engine failure timeout	10000 ms
Maximum number of consecutive data notification failures allowed	0

Instances

- Southerly_GR_Node
- Westerly_GR_Node
- Easterly_GR_Node

2.7.M - \$NEORSUserDefined

Description

The \$NEORSUserDefined represents the starting point for creating custom built objects that include Discrete and Analog Attributes, UDAs, Scripts, Extensions, or Contained objects.

Functional Details

- Additional layer between the derived templates and \$aUserDefined.
- Supports flexibility of design if a common script/attribute/UDA needs created and is common to all areas
- Location of the Placeholder attribute which is distributed to all derived templates
- Addition of this layer supports manufacturer best practices and prevents need to alter BTLs

Attributes

Attribute	Data Type	DESCRIPTION
Placeholder	Boolean	Used as an input source to disable the BTL input source auto populate script

Instances

All derived object templates are derived from \$NEORSUserDefined, see derived object documentation.

2.7.N - \$NEORSViewEngine

Description

The \$NEORSViewEngines are placed on the thin client server or full client nodes and serve as hosts of the managed InTouch application instances.

Functional Details

- Additional layer between the derived templates and \$aViewEngine.
- Supports flexibility of design if a common script/attribute/UDA needs to be created and is common to all View Engines.
- Addition of this layer supports manufacturer best practices and prevents need to alter BTLs.
- Allows for data on a client.

General

Design Element	VALUE
Engine startup type	Auto
Scan period	1000 ms
Enable storage to historian	Unchecked
Scripts – Maximum time for scripts to execute	1000 ms
Scripts - Maximum asynchronous thread count	5 threads
Checkpoint period	0 ms
Checkpoint directory location	C:\Checkpoint
Alarm throttle limit	2000 alarms/s
Statistics average period	10000 ms
Maximum input queue size	16 MB
Engine failure timeout	10000 ms
Maximum number of consecutive data notification failures allowed	0

2.7.O - \$NEORSWinPlatform

Description

- The NEORSWinPlatform represents a server in the automation application and hosts engines, areas, and instances. Platforms should not be derived directly from this template but from the derived platform templates.

Functional Details

- Additional layer between the derived platforms and \$aWinPlatform.
- Supports flexibility of design if a common script/attribute/UDA needs created and is common to all engines
- Addition of this layer supports manufacturer best practices and prevents need to alter BTLs

General

Design Element	VALUE
Minimum Ram	1024 MB
Statistics average period	10000 ms
Enable InTouch alarm provider	unchecked
Redundancy – Redundancy message channel port	30001
Redundancy – Redundancy primary channel port	30000
Message Exchange – Message timeout	30000 ms
Message Exchange – NMX heartbeat period	2000 ms
Message Exchange – Consecutive number of missed NMX heartbeats allowed	3
Message Exchange – Message exchange port	5026

Engine

Design Element	VALUE
Engine startup type	Auto
Scan period	1000 ms
Enable storage to historian	unchecked
Scripts – Maximum time for scripts to execute	1000 ms
Scripts - Maximum asynchronous thread count	5 threads

Design Element	VALUE
Checkpoint period	0 ms
Alarm throttle limit	2000 alarms/s
Statistics average period	10000 ms
Maximum input queue size	16 MB
Engine failure timeout	10000 ms
Maximum number of consecutive data notification failures allowed	0

Instances

See derived instances from \$NEORS DAOS, \$NEORS DClient, and \$NEORS DGR (above).

2.7.P - \$PrinterSelect

Description

The Printer Select Object is used to select a printer from the network and print.

Functional Details

- The PrintSelect printers are entered in the UDA PrinterList. Up to 5 printers may be entered in the string array.
- The PrintSelect printer captions are entered in the UDA PrinterCaption.

Attributes

Attribute	Data Type	DESCRIPTION
PrinterCaption	String	String array are for caption on Faceplate.
PrinterList	String	String array are for selecting printer on Faceplate.

Graphics

- PrinterSelectButton: Allows the user to open the PrinterSelect faceplate to select a printer.



Graphic Number	Design Element	
	Function	Description
1	Select Printer Button	This graphical button allows the user to open the PrinterSelect faceplate to select a printer.

- PrinterSelectFaceplate: Allows the user to select a printer



Graphic Number	Design Element	
	Function	Description
1	Selected Printer	This string is populated with the selected printer after it is set.
2	Printer Options	The available printers configured in the ArchestrA object UDA array.
3	OK Button	The OK button will set the selected printer.
4	Close Faceplate	This will close the faceplate after a printer is selected.

Instances

- Easterly_PrintSelect
- Southerly_PrintSelect
- Westerly_PrintSelect

2.7.Q - \$Screen Object

Description

The Screen Object contains a Node string array which restricts which InTouch windows can send outputs based on which Node the view client is on.

Functional Details

- The screen object must be named same as the InTouch window.
- The Nodes where the window will be used are set in the UDA Node. The string array can contain up to 32 node names.

Attributes

Attribute	Data Type	DESCRIPTION
Node	String	String array are for setting nodes where window is used.

Instances

The screen instances are to be hosted in the appropriate NEORS D plant area (Easterly_Screen_Objects, Westerly_Screen_Objects, Southerly_Screen_Objects).

For example, screens developed for the Southerly plant would have the screen object instances placed in the Southerly_Screen_Objects area.

The various plant areas already exist in the NEORS D galaxy, and should have been provided in the base .cab file provided for Wonderware development.

SECTION 2.8 - DEVICE OBJECT TEMPLATE LIBRARY

All interfaces between PLC and Wonderware HMI applications will use a District approved object. Refer to the NEORS D Standard Object User Manual for a list of the District approved templates.

New ControlLogix applications should utilize the AOI that corresponds to the HMI template. Deviations from this practice require NEORS D approval.

SECTION 2.9 - INTOUCH APPLICATION

2.9.A - \$NEORS View (managed InTouch App)

2.9.B - Description

The InTouch application contains windows, dropped ArchestrA instances, InTouch tags, and a portion of the navigation. This InTouch application is deployed to all of the clients and is run on every node to ensure the same application is seen by everyone.

2.9.C - Functional Details

- All managed InTouch instances will be derived from \$NEORS_View
- The application on Startup determines the NodeName and Client ID
- After 5 second delay the Overview Screen is displayed

2.9.D - Condition Scripts

- \$Inactivity Warning – reference Application Security within for details
- \$Inactivity Timeout – reference Application Security within for details
- NewScreen – provides permission to InTouch tag Perm_Value if you are in the required plant area to operate the targeted equipment on the HMI

2.9.E - Data Change Scripts

- \$AccessLevel – Closes Top Hide Banner if Logged off.
- \$Minute – Opens the ALARM SCREAMER if correct location and active alarm
- Galaxy:ENG_ESDAP.Redundancy.Identity – refreshes alarm query when engine failover for Easterly
- Galaxy:ENG_SSDAP.Redundancy.Identity – refreshes alarm query when engine failover for Southerly
- Galaxy:ENG_WSDAP.Redundancy.Identity – refreshes alarm query when engine failover for Westerly
- GoToScreen – displays specific windows when monitored bit active
- \$OperatorName – On Log off returns correct site menu bar
- MyPrinter – Sets the window printer

2.9-F - QuickFunctions

- GoBack – navigation button
- GoForward – navigation button
- PrintScreen – sets the area of InTouch to be printed
- PushStack – navigation button
- ScreenData – sets remote references
- LoadWindowBanners – Sets location based on the node

2.9.G - InTouch System Windows

Below are a few of the types of windows included in the Wonderware base program, others are added as the system evolves.

- System Large Upper Band Window
- System Small Upper Band Window
- System Footer Window
- Hierarchical Name = \$NEORS D_View
- Derived from = \$InTouchViewApp

SECTION 2.10 - GENERAL CODING PRACTICES

Native InTouch or ArchestrA button commands, object animation, macros, events, etc should be used to perform HMI functions. When using scripts the following practices apply to InTouch, System Platform and ArchestrA Graphic scripts.

Note: “Logic” should be done in the PLC. The HMI should not be calculating values, or making decisions based upon multiple inputs. All logic outside of basic scripting must be in the PLC.

2.10.A - Scripting Code Comment Guidelines

When available, make use of the native comment capabilities of the software development environment. To enhance readability make use of upper and lower-cases when commenting.

2.10.B - Scripting Code Headers

Each written code module should contain a script header unless the script itself is basic in nature using standard COTS functionality. When possible, create a header per the standard indicated below and contained in the supplied developers Galaxy:

- Module Name
- Author name including Company Name supplying the code module
- Brief description of the module function
- Revision history
- Date the module was changed
- Name of the person making the change
- The example below shows a typical Script header

```
{***** Revision History *****}
'Module Name: Script Name
'Author: Michael R Nicolosi (RoviSys)
'Description: Enter a meaningful description that summarizes the functionality (purpose) of the script

'History:
'Rev By    Date    Work OrderModification
'1.0 Michael Nicolosi (RoviSys) dd-Mmm-YY Initial Release Creation of Script
'
*****}
```

Note: When the script has multiple trigger types the default location for the Standard Code Header is in the first one used.

2.10.C - Scripting Code Structure Practices

- Large scripts should be separated into smaller functional elements with each major part commented to indicate what it is doing.
- Show nesting structures clearly by making use of multi-line IF THEN ELSE coding practices.
- Use consistent indentation to show nesting structures clearly. For example make use of multi-line IF-THEN-ELSE and For-Next loops.
- If in-line comments are used make sure they line up to the right of the executable code.
- Add a blank line between after the header, after variable declarations, and above and below nested structures (IF-THEN_ELSE, For-Next etc.)

2.10.D - Dead Code

Good engineering practice is to avoid dead code. Dead code is defined as code that is resident in the program but cannot execute. Comments are not considered dead code.

2.10.E - ArchestrA Device Object Instances

All ArchestrA Object Instances must be created from the appropriate ArchestrA Device Object Template. Reference NEORS D Standard Object Library User Manual for the list of available object templates and design details.

2.10.F - Window Naming Convention

The Wonderware InTouch Window names are limited to 32 characters and will be named to reflect the site, building, process area, and equipment in the following manner.

[Site][Area]_[Process]_[Equip][Train][Parallel]_ [Equip][Train][Parallel]_[Display]

Section 1.5 Point Tag Naming Convention

Point Tag Component	Description	Standard Reference
Site	Plant or Site Designator S, E, W, C	S= Southerly, E=Easterly, W=Westerly, C=Collections
Area	Process Area Code Number	Part II Section 9.1 – two digit numeric code designating the process area
Process/Equip	Process or Equipment Designator.	Refer to Part IV Section 7 – Process, Equipment, and Parameter Abbreviations for suggestions
Train	Process Train Number	Process train number. Not required to use “1” unless “2” or more exists
Parallel	Parallel equipment designator	Alphanumeric character for multiple equipment operating in parallel
Display	Up to a 12 character description for the display type.	Optional field – eliminate if running out of characters. Typical examples include: Overview, Detail, Status, Maint, Setpoint, NAV (for navigation) and Trend

Note: repeat the [Equip][Train][Parallel] portion of the description as necessary to define the screen.

Example:

S47_INC2_CNT_Overview

S = Southerly WWTP
47 = Process Area #47 (incineration)
INC = Incinerator
2 = Train 2
CNT= Centrifuges
Overview = Display type; no parallel equipment noted as it is an overview screen.

S47_INC2_CNT2A_Detail

S = Southerly WWTP
47 = Process Area #47 (incineration)
INC=Incinerator
CNT = Centrifuge
2 = Incinerator Train 2
A = first centrifuge on train
Detail = Display type; a more focused display includes the parallel designator.

Section 2.11 - Display Guidelines

2.11.A - General

- Display window information is to be consistent in presentation especially when multiple copies exist on process lines or trains.
- In general the layout of the windows should follow the process and logically align with the physical equipment to the extent of being easily understood by an operator.
- Fonts used must be consistent and follow the text guideline section of this standard OR must be pre-approved by NEORS D.
- Display windows must be free of typographical errors or graphical discrepancies.

2.11.B - Common

- Windows will contain only information from one building unless it is an overview window
- Window backgrounds will all be the same color (silver) unless a deviation is pre-approved.
- ALL animated objects on the window displays must come from the NEORS D Standard Object Library.
- Standard title bar exists on each window
- Standard Large Upper Band is viewable always
- Standard Footer is viewable always
- DO NOT develop graphical elements that are hidden (not viewable in development mode) in WindowMaker. USE visibility functions available in WindowViewer (runtime environment).
- Window development resolution is 1280 x 1024

2.11.C - Lines

- Lines depicting process piping are static and mimic logical representation of the process.
- When possible it is preferred for process piping flow to enter the screen from the left and exit on the right.
- It is preferred that process piping not cross over, however, this is not always practical. When process lines do cross over (without joining) they must not intersect visibly and break the vertical line only.

2.11.D - Text Guideline

- Do not use periods to denote abbreviations
- Window heading are to be centered and contain both the building number and system name
- Informational text is black

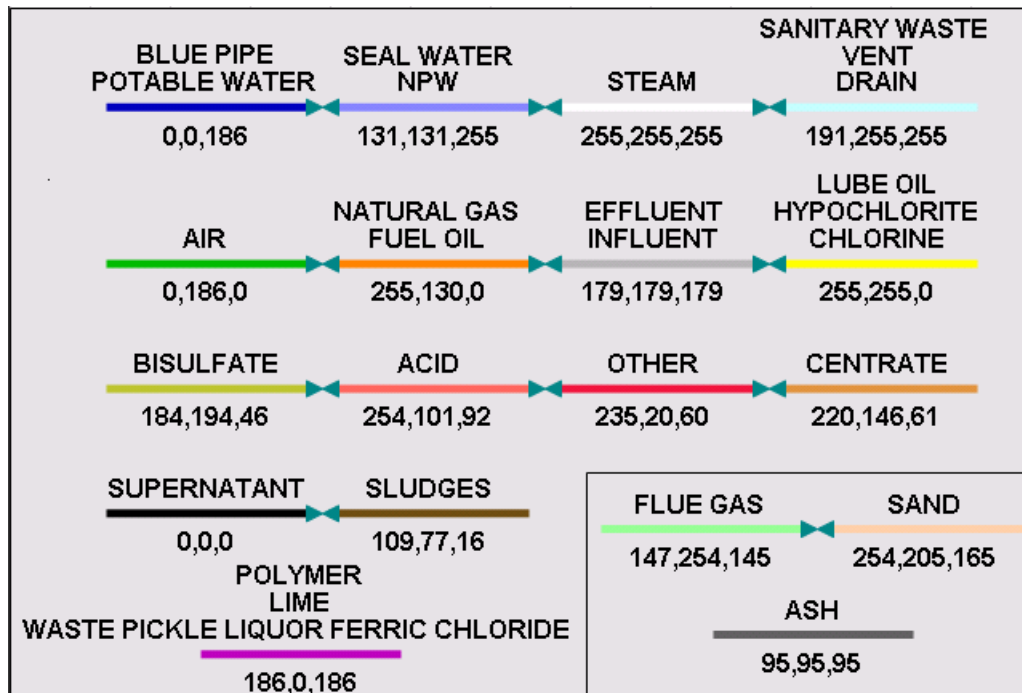
Information Type	Color	Font	Size
Window Header	White	Arial, Bold	16
Title / Heading	Black	Arial, Bold	12
Detail Label	Black	Arial, Bold	10
To/From piping button labels	Black	Arial, Bold, Italic	11

2.11.E - Pipes (InTouch vs ArchestrA)

- Process piping is not dynamic
- Standard piping size is set to 5 points
- Standard Process Colors

Pipe Contents	Color
Potable Water	Blue
NPW	Aqua
Seal Water	Aqua
Steam	White
Drain	White
Vent	White
Sanitary Waste	White
Air	Lime
Fuel Oil	Orange
Natural Gas	Orange
Influent	Gray
Effluent	Gray
Chlorine	Yellow
Hypochlorite	Yellow
Bisulfite	Dark Yellow
Waste Pickle Liquor Ferric Chloride	Purple
Acid	Pink
Lime	Purple
Polymer	Purple
Other	Fuchsia
Centrate	Peach
Supernatant	Black
Sludges	Bronze

Examples:



- Process piping arrows
 - o Use arrows to indicate direction of flow
 - o Use arrows to indicate process flow entering or leaving the display window and include text to indicate source or destination.

2.11.F - Standard Static Process Symbols

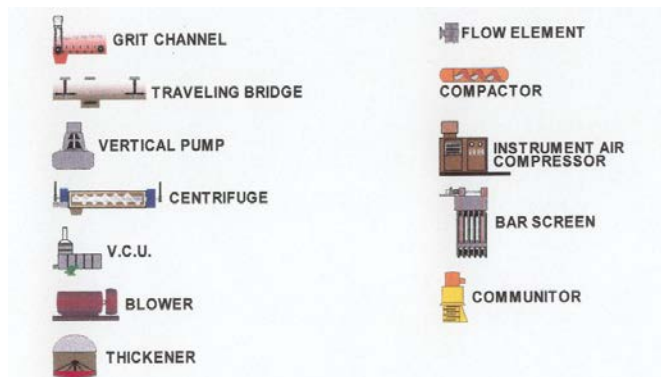
All developed windows must use static process symbols contained within the NEORS library (graphic toolbox).

2.11.G - Locations

ArchestrA object templates / Custom Window / Toolbox

2.11.H - Common Symbols

*Insert screenshots of each approved symbol set – in progress.



Section 2.12 - Standard Symbols

2.12.A - Locations

Reference the NEORS Standard Object Library User Manual.

2.12.B - Common Features

- Symbols change color to indicate equipment status
- Red indicates running or a valve or gate is fully opened
- Green indicates stopped or a valve or gate is fully closed
- Yellow indicates equipment malfunctioning
- Dark Grey indicates information is not available
- Text / Numbers display NaN
- Red status boxes (text) appear when non-alarm process conditions occur
- Yellow status boxes (text) appear when an alarm condition is active

Section 2.13 - Windows

2.13.A - Adding New Windows

- Windows shall be developed from the NEORS D provided window templates which feature site specific coloring.
- To make a new window open one of the template windows, right click in the windows menu and select new. When asked if you want to keep the existing scripts select yes.

Window Properties

- Window Type = Replace
- Frame Style = None
- Title Bar and Size Control = Unchecked
- X Location = 0
- Y Location = 65
- Window Width = 1280
- Window Height = 699
- Window Color = Grey (Right Column, 4th one down on standard palette)

Window Scripts

- Condition Type – On Show
Screen_Name = "<InTouch Window Name";
CALL ScreenData();
NewScreen = 1;
perm_value = 0;
- Condition Type – On Hide
PreviousWindow = Screen_Name;

Navigation

Direct Screen navigation buttons are not used

2.13.B - Navigation

Navigation will be derived from an ArchestrA toolbar object which will contain all of the windows. The tabs on the bar will be organized by process, train, etc. There will be three bars (Easterly, Westerly, and Southerly) and each bar will only be visible for graphics associated with that facility.

2.13.C - Site Specific – Southerly

- Southerly Wastewater Treatment Screen Template

**THE STANDARD COLOR FOR
THESE OBJECTS IN THE SOUTHERLY
WASTEWATER TREATMENT PLANT
PROCESS SCREEN TEMPLATE IS
"NAVY".**

State	TimeLCT	Name	Value	AlarmComment
UNACK_RTN	04/23/13 14:51:02 PM	S30_EF_C_0769_Filter10_FLW.LoLo_...	OK	SEF_F0769I - Filter No 10 Flow Low-Low Alarm
UNACK_RTN	04/23/13 14:51:07 PM	S30_EF_C_0769_Filter10_FLW.Lo_ALM	OK	SEF_F0769I - Filter No 10 Flow Low Alarm
UNACK	04/23/13 14:37:42 PM	S20_RAS_0062_P10_Motor_Overload...	ACTIVE	SCS_I0062U-RAS Pump No. 10 Motor Overload
UNACK	04/23/13 14:37:42 PM	S20_RAS_0062_P10.Fault	FAULT	SCS_Q0062U-RAS Pump No. 10 MALFUNCTION
UNACK_RTN	04/23/13 14:24:25 PM	S36_GBT_0300_OUT_P1_SW_PSI_L....	OK	SGB_P0300L-Pump GBT-TSP 1 Seal Water Low Pr...

Displaying 1 to 5 of 533 alarms | Default | 100% Complete | Eastern Time (US - Canada)

SESSION SVINT
LOG ON
SERVER
SSTSP
SESSION IP 192.168.25.208

2.13.D - Site Specific – Easterly

- Easterly Wastewater Treatment Screen Template

INFLUENT		PLANT_OVERVIEW_EASTERLY										FOREBAY		EFFLUENT		3:48:31 PM 4/23/2013	
88 MGD	7.1 pH											563.2 FT	82 MGD	7.02 pH			
System	Headworks	HW cont.	Primary	Grease React	SP	WW	Aeration	Blowers	Ret Sludge	FST							

THE STANDARD COLOR FOR THESE OBJECTS IN THE EASTERLY WASTEWATER TREATMENT PLANT PROCESS SCREEN TEMPLATE IS "255, 195, 132" (RED, GREEN, BLUE).

Process Area Codes	Quality Legend	SELECTED PRINTER	Select Printer	Print F8	BACK	FORWARD	USER:
State	TimeLCT	Name	Value	AlarmComment			
UNACK	04/23/13 15:47:51 PM	E30_SLTR_3151_P2_ALM.Fault	SEAL W...	EPT_P0122L-SLTR-P002 Low Seal Water PRESS			
UNACK	04/23/13 15:47:51 PM	E30_SLTR_3141_P1_ALM.Fault	SEAL W...	EPT_P0121L-SLTR-P001 Low Seal Water PRESS			
UNACK_RTN	04/23/13 15:47:41 PM	E39_TNK2_0431_MixedLiquorMeter4...	OK	ESW_F0431I - Mixed Liquor Flow From Tnk 2 - Met...			
UNACK_RTN	04/23/13 15:47:39 PM	E09_CW_3351_Grit_Classifier_3.Fault	OK	EHW_M3351U-Grit Classifier 3 Fault			
UNACK_RTN	04/23/13 15:46:47 PM	E30_PSL_0511_P2_Low_FLW_ALM.F...	OK	ESP_Q0511F-PSL-P001-02 Flow LOW			
Displaying 1 to 5 of 324 alarms		Default	100% Complete	Eastern Time (US_Canada)			

SESSION
EVGIT
LOG ON
SERVER
ESTSR
SESSION IP
192.168.17.201

2.13.E - Site Specific – Westerly

- Westerly Wastewater Treatment Screen Template

INFLUENT		PLANT_OVERVIEW_WESTERLY	D.O. CL ₂ RESIDUAL		EFFLUENT		4:06:34 PM 4/23/2013	
22.5 MGD	7.3 pH		7.8 mg/L	0.375 mg/L	23.6 MGD	7.3 pH		
SYSTEM	HEADWORKS	CSOT	PRIMARY	PEPS	SOLIDS	CHEMICAL	EFFLUENT	OPERATIONS

THE STANDARD COLOR FOR THESE OBJECTS IN THE WESTERLY WASTEWATER TREATMENT PLANT PROCESS SCREEN TEMPLATE IS "AQUA".

Process Area Codes		Quality Legend	SELECTED PRINTER	Select Printer	Print F8	BACK	FORWARD	USER:
State	TimeLCT	Name		Value	AlarmComment			
UNACK	04/23/13 11:51:37 AM	W75_NaOCL_Tank2_Level.Lo_Alm		true	NaOCL TANK 2 LEVEL LO ALARM			
UNACK_RTN	04/23/13 04:02:10 AM	W12_PLC.PLC_Seconds_Fault		false	PLC seconds has stopped updating			
UNACK_RTN	04/22/13 14:52:14 PM	W16_PLC.PLC_Seconds_Fault		false	PLC seconds has stopped updating			
UNACK_RTN	04/22/13 11:59:43 AM	w16_805C_south_byp_gate.Fault		OK	Fault indication			
UNACK_RTN	04/22/13 11:59:43 AM	w16_805B_north_byp_gate.Fault		OK	Fault indication			
		Displaying 1 to 5 of 91 alarms		Default	100% Complete Eastern Time (US Canada)			

SESSION WVSUIT

LOG ON

SERVER WSTSP

SESSION IP 192.168.13.220

SECTION 3 - ControlLogix Programming Conventions

Section - 3.0 - Introduction

The conventions outlined below have been compiled from Rockwell's Logix5000 Controllers Common Procedures document (Jan. 2010) and good engineering practice standards developed in conjunction with the NEORS D. These conventions are designed to promote consistency and familiarity in controller logic layout across ControlLogix and CompactLogix systems installed within the NEORS D.

3.0.A - General Programming

All programming should follow good engineering practice. This document identifies standard tasks, programs and routines, as well as general principles to be used in all ControlLogix programming. Additionally, it is required that program logic be grouped by process area or location. Programs shall be descriptively named and thoroughly annotated.

The District reserves the right to request name changes to program Tasks and Routines for general conformity.

Section 3.1 - Firmware Revision

3.1.A - Controller Firmware Revision

New system installations shall use the latest controller firmware revision approved by the NEORS D. Integrators must contact the District for the appropriate controller firmware prior to logic development.

3.1.B - Control Module Firmware Revision

In addition to the controller firmware, at a minimum, communication bridge modules (ControlNet, Ethernet, DeviceNet, etc.) and other high level function modules shall be flashed with the highest level firmware revisions compatible with the specified controller firmware.

Section 3.2 - Controller Naming

The controller name will reflect the process area/building location of the actual PLC (see table in Part II, Section 9.1 for list of process numbers).

The PLC name will follow the format:

[Site][Area]_[Process][Train]X

Where,

[Site] is the site location of the PLC; S=Southerly, E=Easterly, W=Westerly

[Area] is the two digit code for the process area of the PLC. Refer to Part II Section 9.1 for a list of process area codes.

[Process] is the description of the process or primary equipment being controlled by the PLC. Refer to Part IV Section 7 for a list of standard abbreviations.

[Train] is the number associated with the equipment train (1, 2, 3, etc), when applicable. “_CMN” may be used when multiple trains use a common PLC for auxiliary controls.

X is the alphabetical sequence (A, B, C, etc) for parallel pieces of equipment associated with the train, when applicable.

Example: S57_CNT1A, for Southerly building 57, train 1, the first centrifuge.

S47_ICE, for Southerly building 47, incinerator common equipment controls.

Also, the PLC program file name should match the PLC name. Using the first example above, the ControlLogix file name would be S57_CNT1A.acd.

Section 3.3 - Controller I/O

3.3.A - I/O Distribution

I/O is arranged to concentrate related inputs or outputs on single cards so that an I/O card failure will affect only one or two pieces of equipment, i.e., all start/stop/run/fail signals for a given pump are on the same card. However, spare or backup equipment shall be entirely wired to separate I/O cards to avoid losing both pieces of equipment if there is an I/O card failure.

Thorough annotation is required for I/O rack numbers as part of the program documentation.

3.3.B - I/O Electronic Keying

I/O modules will have the electronic keying set to “Compatible Keying”.

Communication modules (CNBT, EN2T, etc) will have the electronic keying set to “Exact Match” to ensure correct firmware revision is installed, which can effect operation of the system.

3.3.C - I/O Module and Remote Rack Naming

Each module must be assigned a unique description to aid in identifying the hardware. The naming convention for modules is defined as:

R#S#_[Rockwell Module Type]

Where,

R# = Rack number

S# = Slot number

[Rockwell Module Type] is the common acronym taken from the Rockwell Module part number.

Examples:

R0S4_IB16 = a 1756-IB16 module in local rack 0, slot 4.

R2S7_OF6CI = a 1756-OF6CI (isolated current) module, in rack 2 slot 7.

R0S5_EN2T = a 1756-EN2T module in Rack 0, slot 5. This is only applicable when connected to an **HMI network**. See naming convention below for remote IO racks.

R1S15_MOD = a generic (third party) module, such as Prosoft Modbus communication card.

The naming convention for a module that links to remote I/O racks (CNB or ENB) is defined as:

[RackLocation]_Rack#

Where,

[RackLocation] = a 2 or 3 letter designator for the process area or equipment associated with the remote rack. Note: one PLC may have remote racks in different process areas.

Rack# = Rack number as assigned in I/O Configuration

Examples:

INC_Rack1 = the second logical rack (Rack 0 is the first rack), located in the fluidized bed incinerator area

DW_Rack2 = the third logical rack, located in the dewatering area

3.3.D - I/O Usage in Logic

Module-Defined controller tags shall be referenced in the controller logic within I/O mapping routines. These routines are designed to provide a single location within the logic where all I/O tag status and values are updated once per program scan to prevent inputs from changing during scan. This is commonly known as buffering I/O. Details in configuring I/O mapping routines are provided in subsequent sections of this document.

Section 3.4 - Controller to Controller Communication

3.4.A - Message Instructions

Controller to controller communication is permitted over the control network through use of message instructions. Preference shall be made to discrete I/O signals for the use of interlocking and control of process points deemed critical or hazardous.

Message instructions offer the following benefits:

- Ability to establish new connections to another controller without taking either controller offline or having to reschedule network
- Programmatically start/stop communications based on events or sequences
- Ability to buffer I/O connection

See section 3.10 for additional guidance on implementing messaging instructions.

3.4.B - Produce/Consume

Produce/Consume communication between controllers should not be used unless a governing need is present and written approval has been given by NEORS D. Programmers should standardize on message instructions based on comparable performance and added flexibility as compared to the produce/consume method.

Section 3.5 - Controller Tags

3.5.A - Tag Naming

Tag naming is explained in detail under Part II Section 1.9.

3.5.B - Tag Scope

All tags communicating with the HMI or OIT must use controller scoped tag formatting. Tags not expected to be linked with the HMI may be program scoped.

This means that the AOIs used in the ContorlLogix program to communicate with the Wonderware object instance need to be controller scoped.

3.5.C - Aliasing

Tag aliasing is not permitted due to limitations in manipulating and readdressing aliased tags online.

3.5.D - User-Defined Data Types (UDTs)

General UDT development, for non-HMI/OIT interface logic, is unrestricted and may be freely used at the programmer's discretion. UDT usage should be thoroughly annotated, with comments provided in the UDT description field, as well as the UDT member description fields.

Program logic that includes tag interfaces to the HMI or OIT should always use the appropriate AOI when possible. Exceptions are only allowed when an existing AOI cannot fulfill the program requirements. The user must review the application with the NEORS D representative and receive permission to deviate from AOI usage. When under contract, the RFI procedure shall be used for UDTs intended for HMI interface.

UDT tag instances are subject to applicable tag naming standards.

Section 3.6 - Task Structure

3.6.A - Task Usage

All logic routines should be organized within periodic tasks within the controller. Periodic logic execution increases performance, in particular controller to HMI communication, by freeing up processor overhead.

Event based tasks are permitted but are generally discouraged unless required for a particular application. Event tasks restricted from use within redundant configurations

Any usage of continuous tasks must be approved by NEORS D.

3.6.B - General Periodic Tasks

Creation of periodic tasks should be kept to a minimum (6 or less) as required by the controlled process or area. Programmers should attempt to organize area logic within programs and routines, as opposed to within individual tasks.

The periodic task execution rate should be set to allow ample time for program execution without burdening the processor. Programmers should frequently monitor and adjust the execution rate based on the task time.

Each periodic task must be set with a priority from 1 to 15, with 1 representing the highest priority. It is recommended that each task be set with a unique priority.

3.6.C - PID Control Task

The periodic task for executing setpoint control and PID based algorithms will be called "PID_Control". Default Rate = 1 sec, and the Priority = 1.

3.6.D - I/O Mapping Task

The periodic task for executing the I/O mapping (including messaging) and alarming logic will be called “IO_Mapping”. Default Rate = 100 msec and Priority = 4.

3.6.E - Process Control Task

The periodic task for the executing the process control and device drivers will be called “Process_Control”. Default Rate = 200 msec and the Priority = 8.

3.6.F - Miscellaneous Logic

The periodic task for executing any non-specific device or process code will be called “Misc_Logic”. Default Rate = 200 msec and the Priority = 13

3.6.G - General Event Tasks

There are currently no standard event based tasks.

3.6.H - Unscheduled Programs and Inhibited Tasks

Following system commissioning, all logic not actively being scanned or no longer required shall be deleted from logic. This includes but is not limited to logic contained within inhibited tasks and unscheduled programs.

Programmers should not programmatically inhibit or uninhibit tasks.

Section 3.7 - Standard Program Structure

3.7.A - General

The term “Program” is the Logix5000 designation given to the “folder” which hosts various logical routines. Programs reside under a specific task.

Programs shall be used to organize the logic by process area or system function. Program names should be intuitive and consistent with area or equipment naming conventions used throughout the PLC code, as well as HMI/OIT development.

3.7.B - PID Control Programs

Programs shall be created under the PID_Control task for organizing the PID loop control logic. The program names shall consist of a prefix referencing the process area or equipment, followed by “_PID). Examples include: “Incinerator1_PID”, “Centrifuge_Pumps_PID”, etc.

3.7.C - Process Control Programs

Programs for process area or equipment control shall be created under the Process_Control task. The program name is not standardized, but should be consistent with area and equipment naming used throughout the PLC code.

3.7.D - I/O Mapping Program

Under the IO_Mapping task, create program areas that align with the type of IO associated with PLC. These programs shall be used to consolidate the logic routines that move source I/O data to an internal PLC tag. This includes physical I/O as well as networked I/O.

The majority of projects will include program folders called “Analog_IO”, “Digital_IO”, “Message_IO”. There may also be networked IO such as ControlNet_IO, DeviceNet_IO, and Modbus_IO.

3.7.E - Miscellaneous Alarms

Under the Misc_Logic task, create a program area called “Misc_Alarms” for alarms not directly associated with a physical IO point, such as OIT alarm triggers.

Section 3.8 - Standard Routine Structure

3.8.A - General

RSLogix5000 allows the use of ladder diagram, function block diagram, sequential function chart, and structured text routines within the logic. Preference to ladder diagrams and function block diagrams shall be made, followed by sequential function charts when deemed appropriate. No logic or configuration shall be written in structured text without prior approval from the District.

3.8.B - Main Routine

Each program folder must contain a ladder routine named “Main” as the main routine. The purpose of the main routine is to govern the flow of the program. The JSR instructions shall be used to reference all other logical routines in the PLC program. No other logic is permitted in the main routine.

It is permitted to condition the JSR with logic to enable or disable the scanning of a particular routine. An example would be the case of using the First Scan bit to run initialization logic.

3.8.C - I/O Mapping Routines

All control I/O, whether physical or network based, should be organized within I/O mapping routines in which the I/O value from the module or otherwise defined tag is “mapped” to a local tag for use within the remainder of the program. These routines provide a central location for all I/O referenced within the controller and assist programmers in assigning and changing I/O.

3.8.D - Analog I/O

All physical analog inputs and outputs should be referenced within individual analog I/O routines. Routines shall be separated by module, and follow a naming standard that references the module rack/slot location as well as signal direction (input or output).

Examples:

R0S4_Analog_Input

R1S5_Analog_Output

R1S1_Analog_IO (for modules with both input and output channels)

Routines will contain IO mapping and scaling logic when necessary.

Analog Input

All ControlLogix analog input scaling shall be performed in the module configuration. For CompactLogix or other cases where scaling cannot be performed within the module configuration, analog scaling will be done in the PLC logic.

Scaling in the module should reflect the engineering units. If multiple units are required in the PLC code (such as RPM and % speed), the second unit range will be scaled in logic.

Unused analog inputs should be disabled in the module configuration to prevent unnecessary alarms.

The NEORS D Analog AOI object may be used to move the module value into a controller tag location and display the value on the HMI. See NEORS D Standard Object Library User Manual for details on AOI usage.

Use of the Analog AOI object is generally recommended but not always required. For example, if the input is not displayed or is manipulated before being displayed on the HMI, the programmer is free to buffer the signal in another manner.

Analog Outputs

Analog output values used within the program shall be scaled as engineering units of percentage (0-100%). If further scaling is needed it should be performed within the I/O mapping routine using CPT or similar functions.

The I/O module configuration will be set for 0-100% to final output signal (ex: 4-20ma).

The NEORS D library does not make use of a standard AOI for analog output handling. Typically, moving the value of a PLC global tag to the output module (via MOV instruction in ladder, or INPUT/OUTPUT RERENCE direct link in function block) is all that is required.

Analog Alarming

Analog alarms associated with input scaling are generated in the Analog AOI. Other methods of analog alarming are permitted, but the resultant alarm output must use a NEORS D AOI to be annunciated in the HMI.

3.8.E - Digital I/O

All physical digital inputs and outputs should be referenced within individual digital I/O routines. Routines shall be separated by module, and follow a naming standard that references the module rack/slot location as well as signal direction (input or output).

Examples:

Part V – CLX/WW/PV+	V-64	Revision 2.0.1
---------------------	------	----------------

R0S5_Digital_Input

R1S7_Digital_Output

R1S6_Digital_IO (for a module with both inputs and output channels)

Routines will contain IO mapping and scaling logic when necessary.

Digital Inputs

The NEORS D Discrete AOI object may be used to move the module value into a controller tag location and display the value on the HMI. See NEORS D Standard Object Library User Manual for details on AOI usage.

In the case where multiple inputs exist that are common to a signal device (i.e. valve limit switch inputs and local/remote indication), the inputs may be directly mapped to the device AOI (Valve_Discrete for example). If the input is required to be annunciated on the HMI or OIT individually, then it will need the Discrete AOI as well.

Digital Outputs

The NEORS D library does not make use of a standard AOI for digital output handling. Typically, moving the value of PLC global tag to the output module (via XIC/OTE pair in ladder, or INPUT/OUTPUT RERENCE direct link in function block) is all that is required.

Digital Alarming

Alarms associated with the state of a digital input are generated in the Discrete AOI. Other methods of digital alarming are permitted, but the resultant alarm output must use a NEORS D AOI to be annunciated in the HMI.

In the case that an alarm is ‘active-low’ (i.e. the field input is normally ‘1’ and the alarm is active when the input signal goes to ‘0’), ensure that the active value is inverted to ‘1’ within the PLC. This is applicable to safety signals such as emergency-stop switches. Within the Wonderware HMI, all alarms are expected to be “active-high” for ease of troubleshooting.

3.8.F - Network I/O

For non-rack-mounted I/O that reside on high level network protocols, such as valves and motors on DeviceNet, Modbus, etc., separate routines should be created to house their specific I/O. Routines should be segregated by scanner module rack/slot location as well as by network port or channel name (A/B, etc.).

Examples:

R0S4_DeviceNet_A

R0S5_Modbus_A

R0S5_Modbus_B

Network IO routines should contain mapping logic for all IO within that particular network port or channel. This includes both analog and digital, both inputs and outputs.

3.8.G - Message I/O

All tag values passed through message arrays should be separated from other I/O into message specific I/O mapping routines. An individual routine is required for each controller whose data is obtained via a message instruction. Message routines should be named by applying the prefix “MSG_” to the paired controller’s name. An example would be “MSG_S47_INC1”.

All messaging should be performed over Ethernet. Messaging over a DeviceNet network is not permitted.

See section 3.10 for more messaging details and examples.

3.8.H - General Alarms

Analog alarm functionality is handled in the Analog_IO routines, using the appropriate AOI. Similarly, alarming from digital input values are generated in the Digital_IO routine using the Discrete AOI. All other alarm logic shall be located near related logic or grouped within routines under the “Misc_Alarms” program. Typically this will include alarm logic that is shared by both the HMI and OIT.

PanelView alarm triggers will be grouped in a routine called “PanelView_Alarms” under the “Misc_Alarms” program. It is permissible to place alarm logic limited to the PanelView within this routine.

All alarms will be generated in the PLC in the form of discrete (alarm active/not active) signals. The programmer should not anticipate using alarm features typically available in the HMI. Additionally, the PLC logic will be programmed such that the alarm condition occurs on “true” (Alarm when discrete = 1); no conditioning of the alarms are permitted in the HMI.

3.8.I - PID Loops

Individual PID routines shall be created under the corresponding PID program. Routine names shall consist of the specific control loop name. Naming shall be consistent throughout the PLC code.

Examples include:

Incinerator1_Air_Flow

Boiler1_Level

3.8.J - Process Control Routines

Process control routines shall be created under the corresponding Process Control program area. Routine names shall consist of the specific device name. Process names shall be consistent throughout the PLC code.

Section 3.9 - Initialization Logic

3.9.A - General

System critical variables and control modes shall be initialized at controller startup. The preferred method is to utilize the processors “First Scan” bit, but other techniques are allowed. It is the contractor’s responsibility to review the specific process needs for initialization logic with the District, on every project.

3.9.B - Initialize Routine

Include a routine named “Initialize” under each program area that requires initialization logic. Condition this routine in the “Main” routine using the controller’s S:FS bit (system first scan).

Note that the NEORS D AOI library objects utilize pre-scan routines that initialize each AOI prior to executing the AOI main logic.

Section 3.10 - Message Instruction Guidelines

3.10.A - General

Messaging is hosted in the local controller and can only execute CIP Data Table Read command. Programs should never write data to another controller without written authorization from NEORS D.

All messaging should be performed over Ethernet. Messaging over a DeviceNet network is not permitted.

In a redundant processor system, the messaging must take into account the dual network pathways. If one network is down, the messaging will continue over the remaining pathway.

A failed message command should automatically reset itself after an appropriate amount of time.

Messaging should not be used to communicate HMI signals to a PLC. If a direct Ethernet connection to the PLC is not available to the HMI, contact your District representative.

3.10.B - Organization

Messaging logic should be organized into two program areas:

IO_Mapping → Message_IO

- Use individual routine for each PLC.
- Organize instructions into common order: map Send data (data to be read by other PLC), map Receive data.
- Data is organized into DINT and REAL, requiring separate message instructions, per PLC.

Misc Logic → Message_Control

- MSG_Control routine should contain the logic for regulating the execution of the MSG commands, as well as error handling.
- Use separate routines for each PLC being messaged.

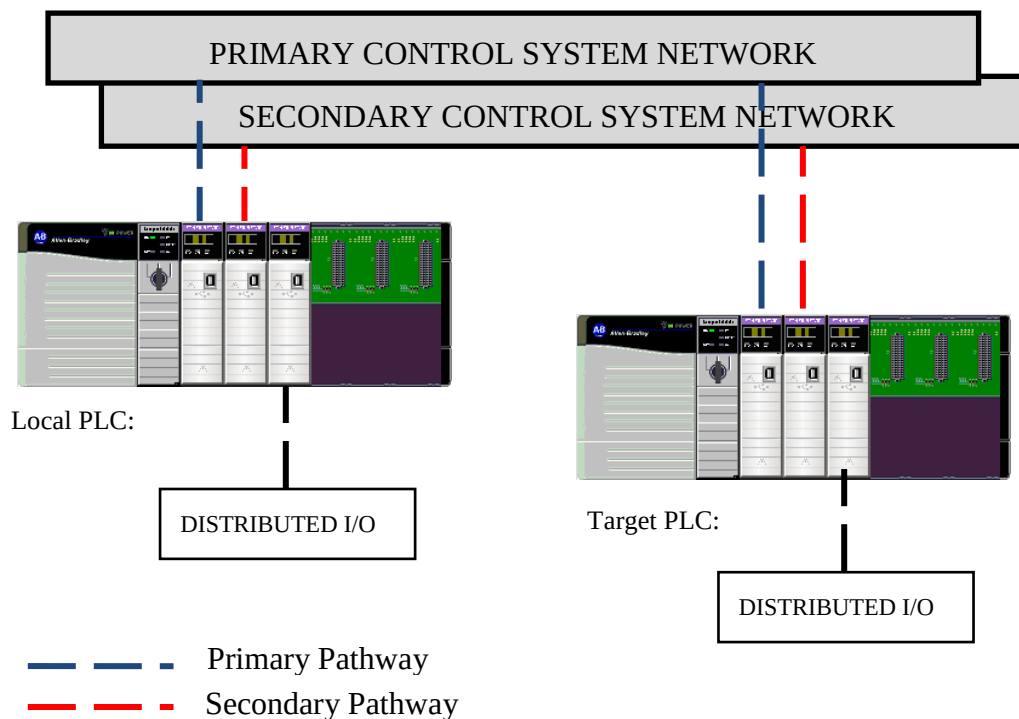
3.10.C - Peer Messaging Guidelines

This section provides further details regarding messaging structure, data format and code examples.

Peer to peer communications for PLC's within the NEORSD facilities should satisfy the following requirements:

- Use MSG instructions hosted in the local controller to execute CIP Data Table Read
 - MSG instructions should only “read” (CIP Data Table Read) data from other PLCs; never “write”.
 - Produce/Consume not used
- Organize MSG data mapping routines under IO_Mapping
 - Individual routine for each PLC
 - Organize instructions in common order: map Send data, map Receive data
 - Data organized in DINT and REAL arrays, requiring separate MSG instructions per PLC
- Organize MSG control logic under Misc_Logic routine
 - Logic includes a sequencing operation to regulate MSG execution
 - Execute messaging over both network pathways simultaneously
 - Monitor watchdog from target PLC (looping 60 second time). Take corrective action if watchdog value goes stale.
 - Automatic reset of failed messages
 - Provide network status (primary/secondary) and comm status (ok/fail, based on watchdog) on OIT
- Tag Naming should follow a consistent pattern
 - The Discrete objects associated with alarming, which may be displayed on the OIT and HMI, must follow a specific format to ensure they are unique within the Wonderware Galaxy.
 - The internal tags associated with the message command and data arrays should be consistent and follow the examples provided in this document, and ultimately the District Automation Standard.

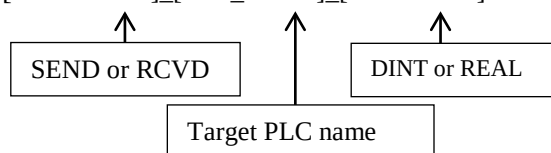
Typical Messaging Architecture



Message Data Tags (DINT/REAL) and MSG tags

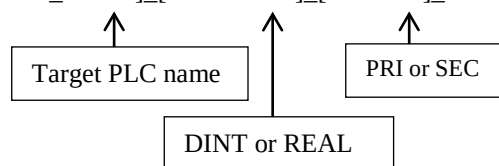
Data array tag name format:

[DIRECTION]_[PLC_NAME]_[DATATYPE]



MSG instruction tag name format:

[PLC_NAME]_[DATATYPE]_[PRI/SEC]_MSG



Message Alarm Tags

Alarms are generated from the Primary and Secondary MSG error bits, as well as the Watchdog fault (both primary and secondary MSG errors). Discrete objects must be used to map these alarms into the OIT and HMI. Since the alarm tags are a part of the Wonderware galaxy, each tag must be unique. Use the following format when naming these tags:

[Local_PLC_Name]_[PRI_MSG_FLT]_[Target_PLC_Name] (ex: 47_INC1_PRI_MSG_FLT_S47_ICE)

[Local_PLC_Name]_[SEC_MSG_FLT]_[Target_PLC_Name] (ex: S47_INC1_SEC_MSG_FLT_S47_ICE)

[Local_PLC_Name]_[WatchDog_FLT]_[Target_PLC_Name] (ex: S47_INC1_WatchDog_FLT_S47_ICE)

1/30/2012 204 - MAINTENANCE - COMMS DEFAULT 9:50:37 AM MTN (K11) ALM (K12)

Sample OIT Message Status Display

Discrete object templates are used for all Primary, Secondary, and Watchdog alarms.

Locate under the MAINTENANCE area within the OIT application.

Alarms need to be added to the OIT alarm summary.

The AOI object should be configured for alarming.

HMI graphics can be developed in similar fashion (Watchdog timeout is not necessary as it cannot be seen at the HMI if both networks are down).

PLC 4 n Status	PLC 5 Comm Status
PRIMARY OK	PRIMARY OK
SECONDARY OK	SECONDARY OK
WATCHDOG OK	WATCHDOG OK
PLC 9 n Status	PLC 10 Comm Status
PRIMARY FAULT	PRIMARY FAULT
SECONDARY FAULT	SECONDARY FAULT
WATCHDOG FAULT	WATCHDOG FAULT

Message Example

Local PLC (S47_INC1) is the PLC to receive data from the target PLC (S47_ICE).

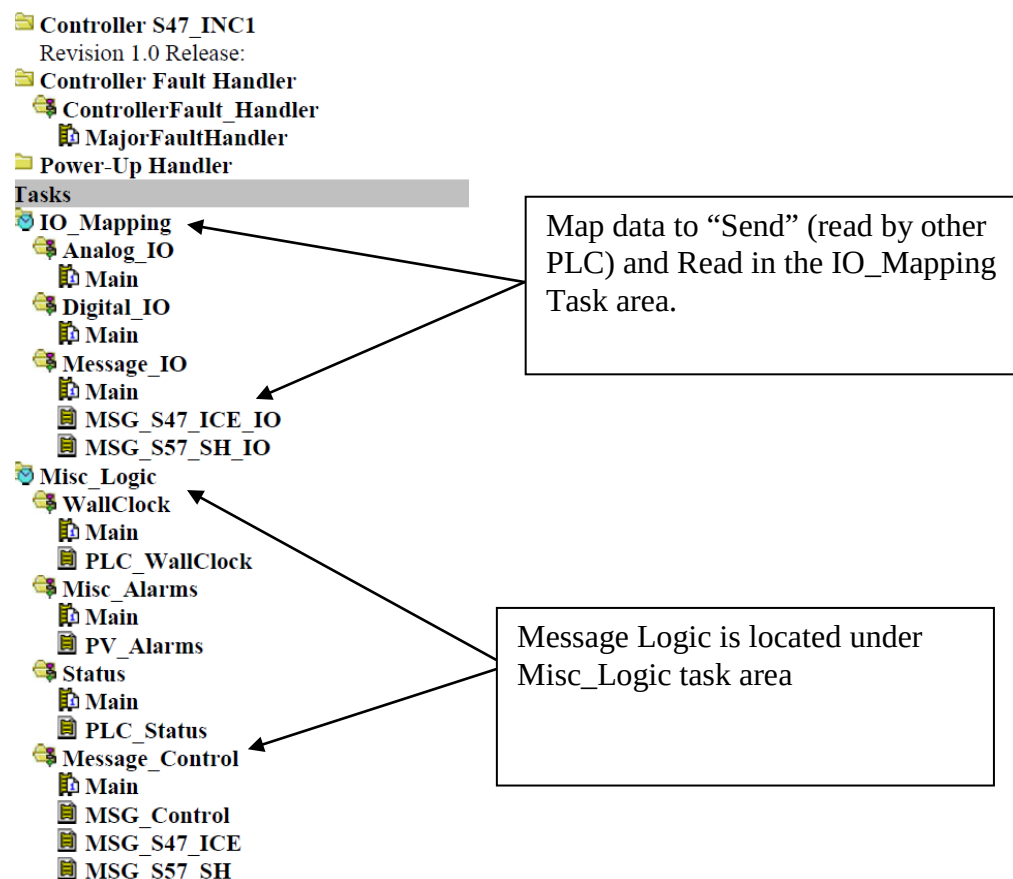
Secondary message instruction includes same source and destination tags, but has different Ethernet IP addressing.

S47_INC1 Message Tags	
<i>Send Data</i>	<i>In addition to receiving data from the ICE PLC, the S47_INC1 will be “sending” data to the ICE PLC.</i>
SEND_S47_ICE_DINT[x]	Mapped DINT or packed BOOL values in S47_INC1, for S47_ICE to read
SEND_S47_ICE_REAL[x]	Mapped REAL values in S47_INC1, for S47_ICE to read
<i>Receive Data</i>	<i>This is the data the local MSG commands pulled from the target PLCs.</i>
RCVD_S47_ICE_DINT[x]	Destination tag in S47_INC1 for DINT or packed BOOL values, read from S47_ICE
RCVD_S47_ICE_REAL[x]	Destination tag in S47_INC1 for REAL values read from S47_ICE
<i>MSG Instruction Tags</i>	<i>In the local PLC. A set of instructions for Primary and Secondary pathways, for both DINT and Real.</i>
S47_ICE_DINT_PRI_MSG Source: SEND_S47_INC1_DINT[x] Dest: RCVD_S47_ICE_DINT[x]	Primary message to read S47_ICE DINT array Source tag, as created in the target PLC Destination tag, as created in local PLC
S47_ICE_DINT_SEC_MSG	Secondary message to read target PLC DINT array
S47_ICE_REAL_PRI_MSG Source: SEND_S47_INC1_REAL[x] Dest: RCVD_S47_ICE_REAL[x]	Primary message to read target PLC REAL array Source tag, as created in the target PLC Destination tag, as created in local PLC
S47_ICE_REAL_SEC_MSG	Secondary message to read target PLC REAL array

Code Example

The following code example includes logic within PLC S47_INC1, to message between PLC S47_ICE. A second PLC (S57_SH) is also configured, but the logic is not shown, since the messaging principle is represented with one example.

The Main program routines are not shown in the images below. It is understood that all Main routine utilize JSR instructions to execute the program logic. See Section 3.8.B for additional details.



MSG_S47_ICE_IO - Ladder Diagram

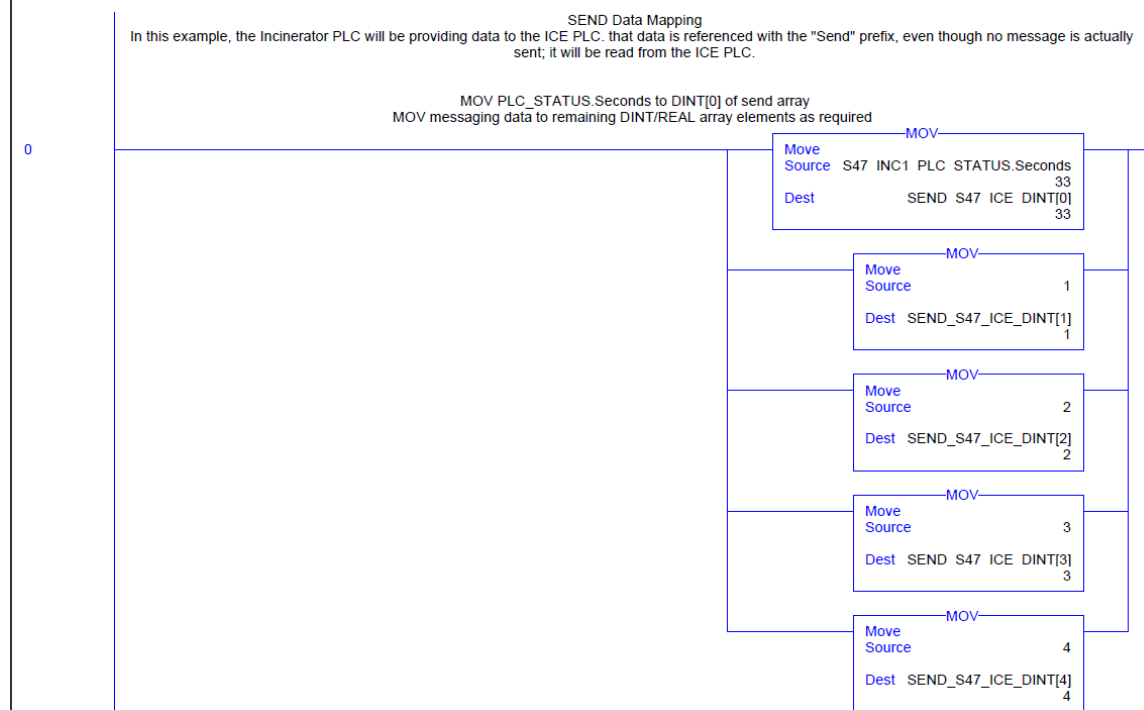
S47_INC1:IO_Mapping:Message_IO

Total number of rungs in routine: 5

...ts\My Projects\ NEORS\Object Library\CLX_MessagingSample.AC

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MSG_S47_ICE_IO - Ladder Diagram

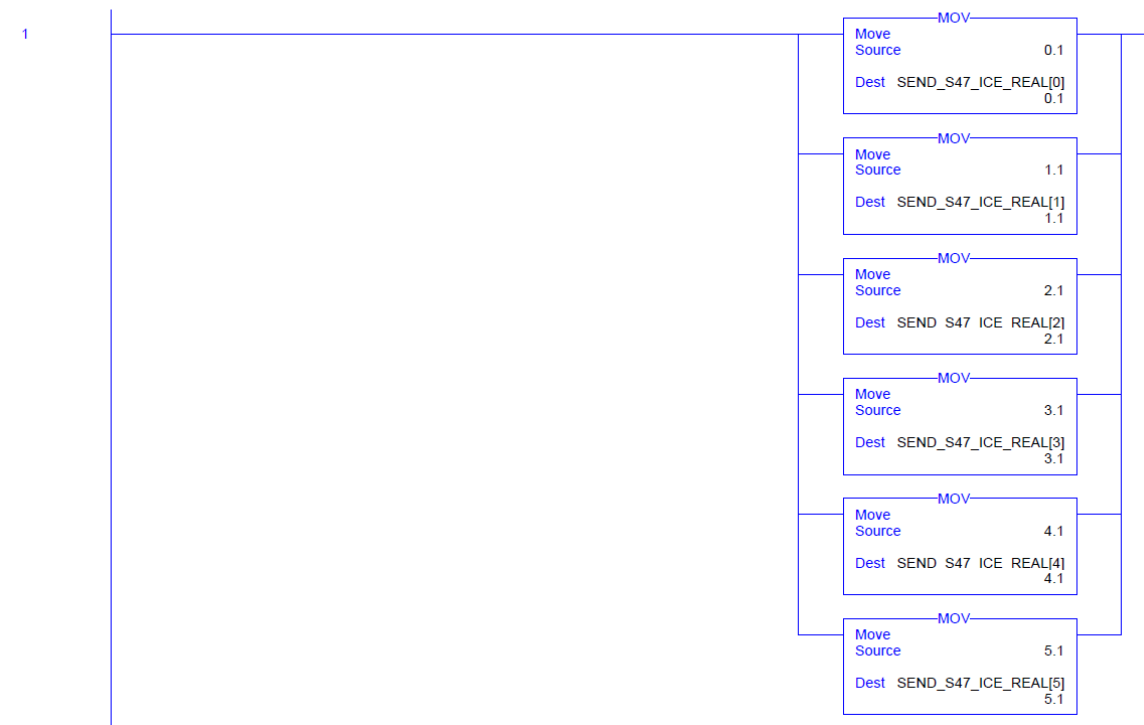
S47_INC1:IO_Mapping:Message_IO

Total number of rungs in routine: 5

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MSG_S47_ICE_IO - Ladder Diagram

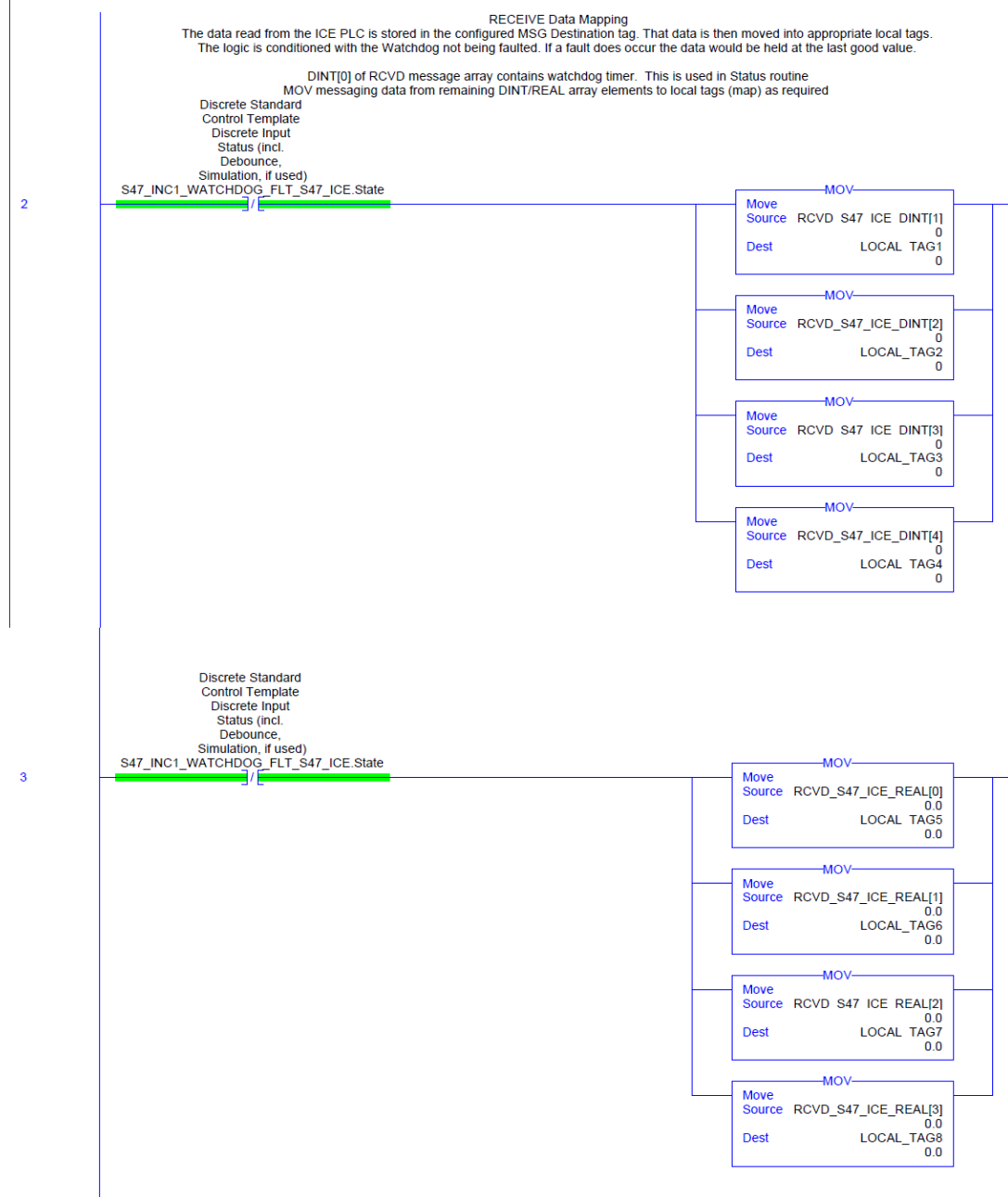
S47_INC1:IO_Mapping:Message_IO

Total number of rungs in routine: 5

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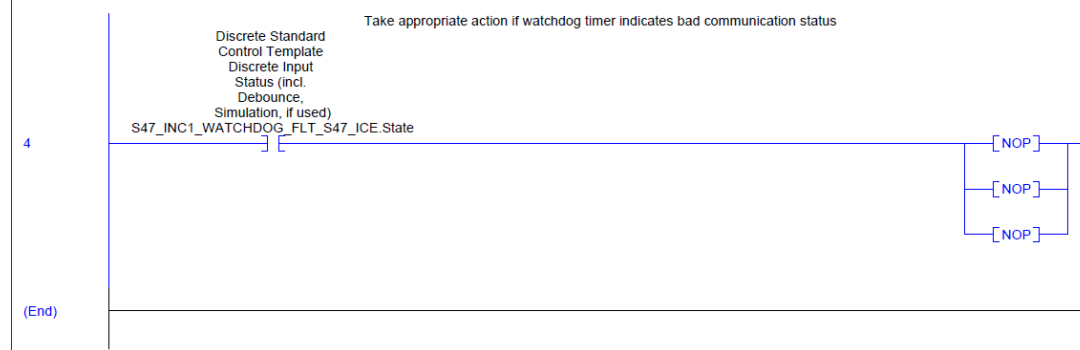
MSG_S47_ICE_IO - Ladder Diagram

S47_INC1:IO_Mapping:Message_IO

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Total number of rungs in routine: 5

...ts\My Projects\ NEORS\Object Library\CLX_MessagingSample.ACI



MSG_Control - Ladder Diagram

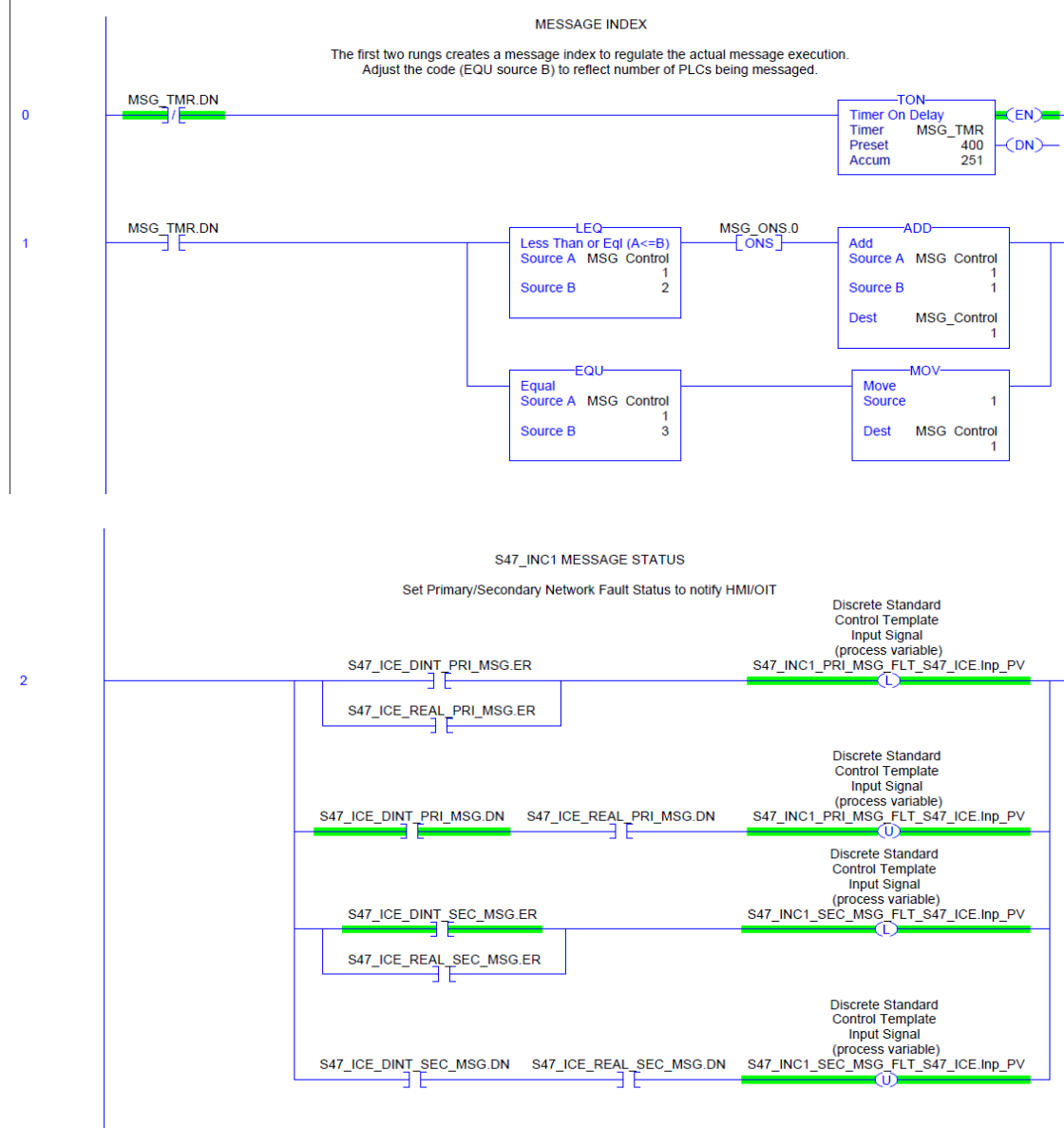
S47_INC1:Misc_Logic:Message_Control

Total number of rungs in routine: 16

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MSG_Control - Ladder Diagram

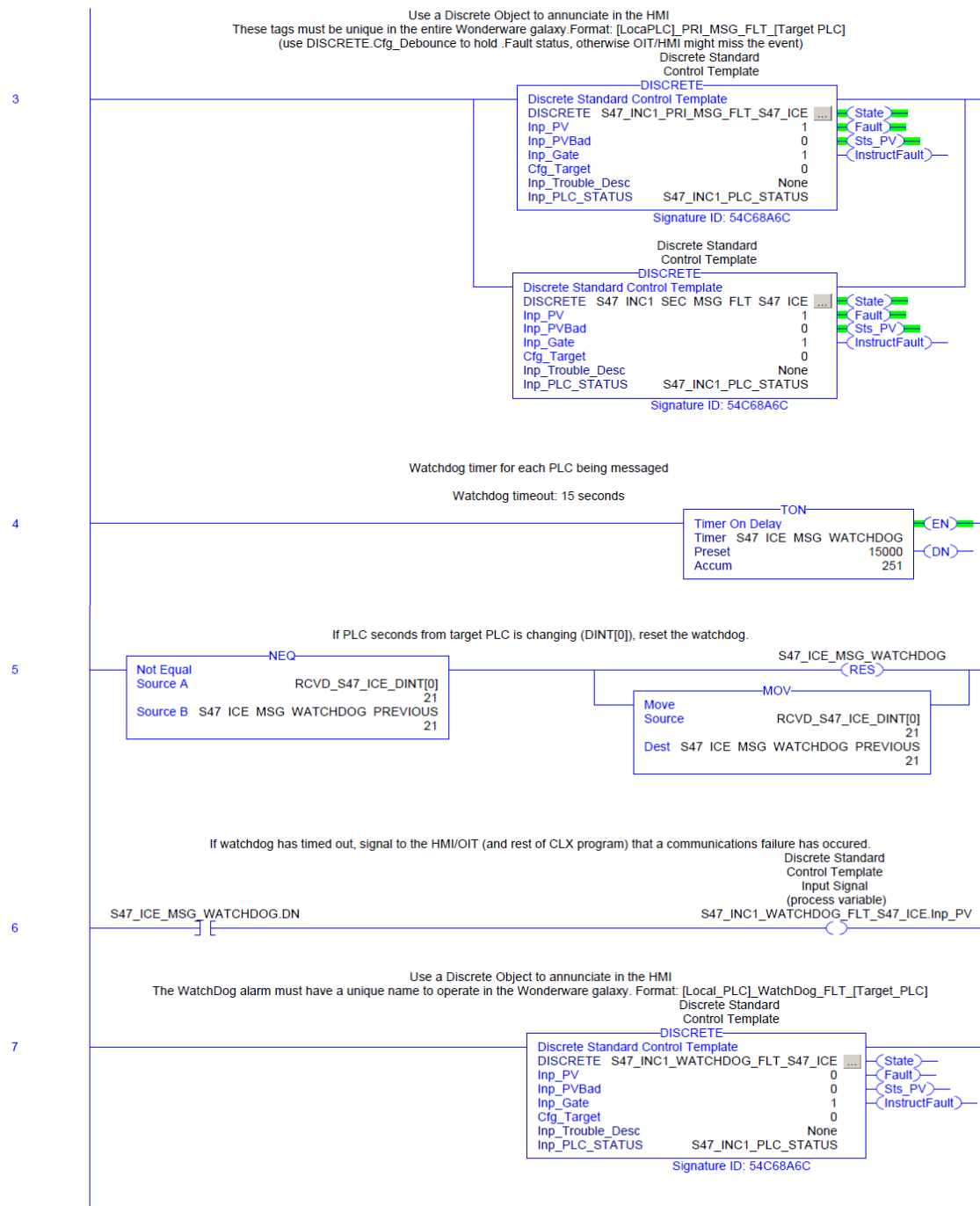
S47_INC1:Misc_Logic:Message_Control

Total number of rungs in routine: 16

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MSG_Control - Ladder Diagram

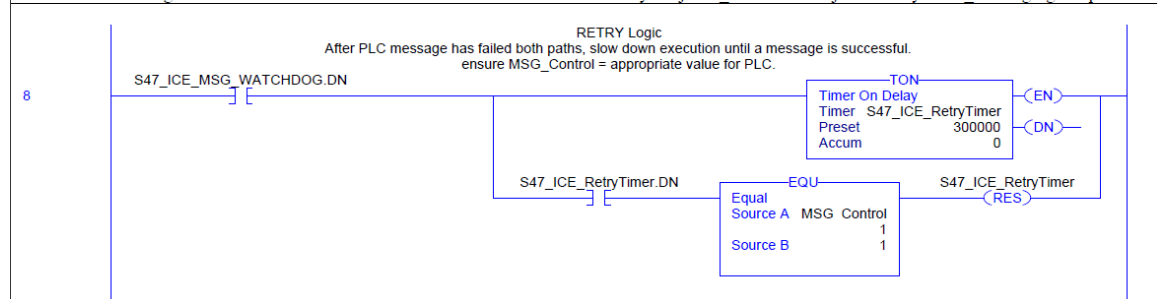
S47_IN1:Misc_Logic:Message_Control

Total number of rungs in routine: 16

...ts\My Projects\ NEORS\Object Library\CLX_MessagingSample.ACD

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MSG_S47_ICE - Ladder Diagram

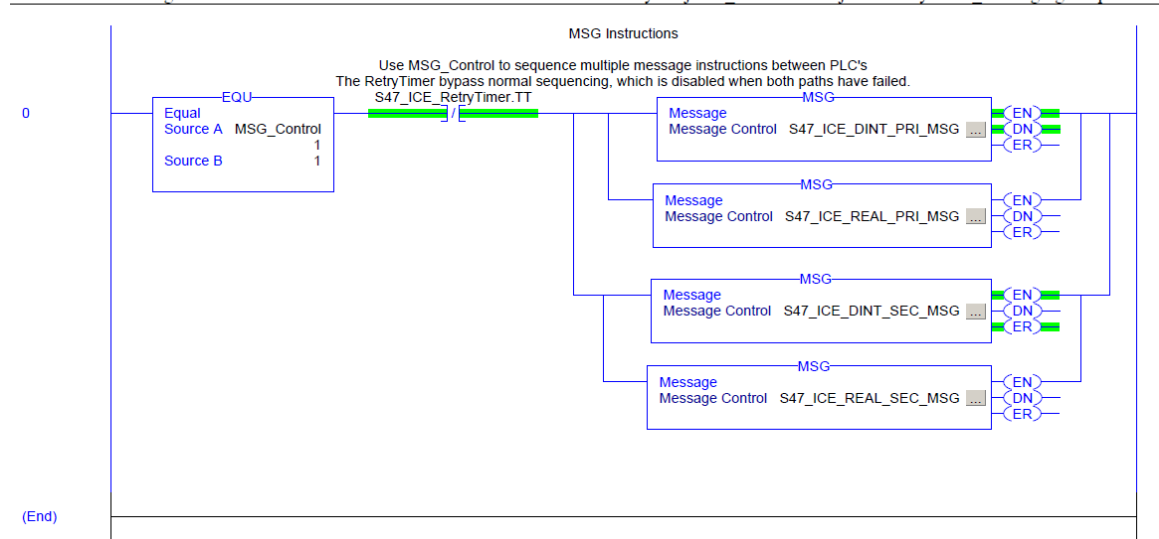
S47_IN1:Misc_Logic:Message_Control

Total number of rungs in routine: 1

...ts\My Projects\ NEORS\Object Library\CLX_MessagingSample.ACD

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Section 3.11 - General Coding Guidelines

3.11.A - Commenting Logic

All logic routines must be clearly commented in the rung description.

The first rung of a routine should summarize the overall routine function, as well as the logic found on the rung.

When similar functionality is being repeated, a brief description clarifying the relative differences from the fully comment rung is acceptable.

All changes made after commissioning must be commented. Post commissioning comments require the following:

- Date of change
- Initials of person making the change
- Company that employs the person making the change
- Reason and description of change

Example: 12/02/10 – JBZ – RoviSys – Added an example to the standard.

3.11.B - Indirect Addressing

Indirect addressing in the form of passing input parameters between subroutines and accessing values within array elements should be minimized within the program as much as possible. The use of the instruction “FOR” to loop through a subroutine repeatedly should similarly be avoided. If indirect addressing is used, it must be thoroughly documented.

3.11.C - Subroutine Nesting

Programmers shall limit the depth of ladder subroutine level jumps to 2 (MainRoutine → Subroutine1, Subroutine1 → Subroutine2).

Programmers should not use JSR instructions to jump up or back out of routines. Use the RET instruction instead.

3.11.D - Output Instructions

Output instructions (OTE, MOV, Timers, etc.) must be located to the right of all input instructions located on the corresponding rung or branch. Output instructions should not be located in between or to the left of any other input instructions.

Multiple outputs per rung are permissible. Programmers should make use of rung branches to organize and condense multiple outputs, to aid in viewing rungs.

3.11.E - Function Block Sheets

Function block subroutine should be contained on a single sheet when possible to ease review/troubleshooting. When multiple sheets are unavoidable, the programmer should organize

the sheets such that each sheet contains a set of logic pertaining to a single area or piece of equipment.

Programmers should adjust the sheet size to accommodate grouped logic within a single sheet. Programmers shall also provide adequate spare sheet space for future logic.

3.11.F - Simulation of Logic

Adding code to simulate normal operating conditions, for testing purposes, is permitted. Please segregate programs and routines of simulation logic in order to aid removal prior to commissioning.

Simulation shall only be enabled through the PLC programming software, not from OIT or HMI.

3.11.G - Fault Resets

There shall be no automatic resetting of faulted hardware, such as VFDs. The PLC logic will create a fault alarm that is annunciated at the OIT and the HMI. Typically, software faults should be programmed so that the hardware fault must be cleared first before the software fault will clear.

3.11.H - Forced Logic

Use of forced logic for normal operation is not permitted. Forcing logic during testing is acceptable but all forces must be removed when the system is placed in service.

The “forces enabled” status will be made available on the HMI as part of the normal execution of the PLC_Status object.

3.11.I - Alarm Horn and Light Acknowledging

Alarm logic may latch alarm annunciation (horn or light) but not the alarm. To silence the horn and stop a flashing light, the following tags should be created in the PLC:

PV_ACK (BOOL)

PV_SILENCE (BOOL)

The PanelView Plus 6 will manipulate for reset or alarm action.

PLC

PV_ACK will be toggled by the PanelView Plus 6 any time an alarm is acknowledged or the “Ack All” button is pressed on the Alarm Summary.

PV_SILENCE will be toggled by the PanelView Plus 6 any time the “Silence” button is pressed, an alarm is acknowledged, or the “Ack All” button is pressed on the Alarm Summary.

OIT

The following configuration must be added to the base PanelView Plus 6 applications:

Alarm Setup:

Triggers Tab

Check “Use ack all value:” 1

“ACK” = {::[PLC]PV_ACL}

Advanced Tab

“Hold Time (ms):” 1000

SILENCE = {::[PLC]PV_SILENCE}

Section – 3.12 - General Control Mode Philosophy

3.12.A - Local Control Modes

All equipment will have local manual control capability at or near the associated equipment. Equipment that can also be controlled remotely by the PLC will have a Local-Off-Remote selector switch at that piece of equipment to select control location. If the selector switch is in the Local position, the local manual control will be enabled and the remote control and PLC control will be disabled.

3.12.B - Remote Control Mode

When the Local-Off-Remote selector switch for the equipment that can be controlled remotely is in the Remote position, the remote control and PLC control will be enabled and the local manual control (except for stop push buttons) will be disabled. Where multiple remote control locations are available such as OIT and HMI, both controls are available simultaneously with no priority given to one or the other. The OITs are intended for use in maintenance.

In some cases, there is more than one level of remote control. In the case of a VFD driven pump or blower, for example, local control is provided by a Local Control Station (LCS) at or near the piece of equipment as the VFD is usually remote from the equipment. The remotely located VFD then acts as a first layer of remote control. The OITs and HMIs, together, form the second layer of remote control. To separate the two layers of remote control, a switch, labeled VFD/PLC, shall be provided on the panel containing the VFD.

Operation

- a. When the Local/Off/Remote switch on the LCS is in the Local Mode, the equipment shall be controlled via start and stop pushbuttons on the LCS.
- b. When the Local/Off/Remote switch on the LCS is in the Remote Mode and the VFD/PLC switch at the VFD is in the VFD mode, start/stop and speed control will be manually adjusted by the operator at the VFD.
- c. When the Local-Off-Remote switch on the LCS is in the Remote Mode and the VFD/PLC switch at the VFD is in the PLC mode, the PLC will be allowed to control the equipment based on control values entered by the operator. The PLC will control the equipment in either a PLC Manual or a PLC-Auto mode of operation, as selected by the operator at the HMI.
 - 1) PLC-Manual Control: The PLC-Manual mode of control requires operator action at the HMI to change the operating status of the piece of equipment.
 - 2) PLC-Auto Control: PLC-Auto control allows the PLC to control the equipment based on operator-entered Setpoints and measured values (using PID algorithms).
 - 3) Out-of-service: In this mode, selected at the MCS, the equipment is considered unavailable by the control system. Indicate at the MCS equipment that is out of service and manage alarms accordingly.

3.12.C - Control Mode Functions

Remote Manual control: It shall be possible for the Operator to interrupt any sequence, loop, or automatic operation and operate the same manually through the operator workstation or OIT.

Protective Interlocks: Equipment protective, hardwired interlocks shall remain in effect in all control modes.

Section 3.13 - Add On Instruction (AOI)

3.13.A - Usage

The NEORSD has created a library of Add-On Instructions to be used for program development. Any communication between the PLC and the HMI or OIT must utilize a District approved AOI. Refer to NEORSD Standard Object Library User Manual for a complete list of the current AOI and configuration instructions.

It is expected that the contractor will populate all parameter fields of the NEORSD Object AOI, regardless of contract requirements. Any exceptions must be reviewed with the NEORSD project manager.

UDT (user defined data type) are only allowed when an existing AOI cannot fulfill the program requirements. The user must review the application with the NEORSD representative and receive permission to deviate from AOI usage.

Additional AOI usage, in either ladder or function block, is not restricted and may be freely used at the programmer's discretion. AOI usage must be thoroughly annotated. AOI tag instances are subject to applicable tag naming standards.

3.13.B - Source Protection

Source protecting AOI is prohibited without approval from NEORSD. For any protected AOI, logic must be fully viewable by the District and a function description outlining performance must be provided.

SECTION 4 - PANELVIEW PLUS 6 PROGRAMMING CONVENTIONS

Section 4.0 - Introduction

This section outlines the Allen-Bradley PanelView Plus 6 programming standards in place for NEORS. These conventions are designed to promote consistency and familiarity in design and layout across all OIT's installed within the District.

The practices outlined below have been compiled from good engineering practices promoted by Rockwell Automation and those developed by the District.

Note: It is the District's intention to have the PLC/PanelView OIT Ethernet network separate from the PLC/HMI control Ethernet network. This requires multiple Ethernet modules in the PLC rack.

Section 4.1 - Software

Integrators shall request the type and version of Rockwell software currently in use at the District for PanelView application development. The software should be patched with the most recent patch rollup available from Rockwell prior to application development.

Section 4.2 - Standard PanelView Framework

4.2.A - Overview

The District maintains a base PanelView project to provide integrators with a starting point in creating new applications. The base project contains example displays that use the screen size, font, display colors, etc, and other application attributes that adhere to the standard as described in the sections below.

Note that the District standard is for PanelViews with key pads and touch screens.

The base PanelView project also contains a set of Global Objects that provide the foundation for PanelView application development. The Global Objects templates are designed to simplify PanelView application development as well as promote consistency on HMI interfaces both between systems and across PanelView and Wonderware platforms.

4.2.B - Standardized Objects and Functions

The PanelView Global Objects standard library contains object symbols that may be dragged and dropped into PanelView HMI graphics. These symbols are already configured for animation, textual message displays, and faceplate links for operator interaction. It is the application programmer's responsibility for selecting the correct Global Object from the library and configuring that particular instance for ControlLogix tag and description attributes.

Section 4.3 - Project Settings

4.3.A - PanelView Application Name

The PanelView application name should incorporate the site, building, process, and equipment information as defined below:

[Site][Area]_[Process][Train][X]_OIT[Alpha]_[FTversion]

Where:

[Site] – Site designator for Westerly (W), Southerly (S), or Easterly (E), Collections (C).

[Area] – Two digit process area code as provided by the District. Refer to Section 9.1 for a listing of the process area numbers.

[Process] – The character reference to the process or equipment area being monitored and/or controlled as defined in Part IV Section 7.

[Train] is the number associated with the equipment train (1, 2, 3, etc), when applicable. _CMN may be used when multiple trains use a common PLC for auxiliary controls.

[X] is the alphabetical sequence (A, B, C, etc) for parallel pieces of equipment associated with the train, when applicable.

[Alpha] – Unique alpha character identifying PanelViews that otherwise would have the same tag descriptor. Characters must be assigned alphabetically. The alpha code is not required for process or equipment with only a single PanelView Plus 6 terminal.

[FTversion] – The version of FactoryTalk View ME used to create the application. Use “p” for the decimal point. Ex: Version 6.1 would be expressed as 6p1.

Examples:

S57_CNT1A_OIT_6p1 (*The PanelView Plus6 terminal associated with Southerly building 57, train 1, first centrifuge, version 6.1*)

S47_WSC3_OIT2_6p0 (*The PanelView Plus 6 terminal associated with Southerly building 47, wet scrubber, train 3, panel 2, version 6.0*)

4.3.B - Project General Settings

The project window size must correspond to the target PanelView Plus 6 (or current series) device.

FactoryTalk View ME automatically sizes the display to match the window size of the target PanelView Plus 6 (or current series) device designated in the project settings. The default window sizes are as follows:

PV Plus 6, Model 700	640x480
PV Plus 6, Model 1250	800x600
PV Plus 6, Model 1500	1024x768

A custom window size for the application is not permitted.

4.3.C - Project Runtime Settings

The default project runtime settings within FactoryTalk Studio ME should be used for project development. Specifically, projects must follow the format below:

- Disable title bar (uncheck)
- Disable border (uncheck)
- Project window position of Top: 0, Left: 0
- Enable auto logout
 - Inactivity Period: 10 minutes
 - Uncheck Return to Graphic on Logout

4.3.D - Internal Clock Synchronization

In order to synchronize time displays across control network interfaces, the PanelView Plus 6's internal clock should be synchronized with the internal clock of the main PLC the application communicates with.

PanelView Plus 6 synchronization is achieved by configuring the following Global Connections within the application:

Connection	Tag or Expression	Description
Remote Date and Time	{{[PLC]CLOCK[3]}==0}	Sets clock on rising edge trigger at 12:00 am
Remote Year	{[PLC]CLOCK[0]}	Year GSV Value
Remote Month	{[PLC]CLOCK[1]}	Month GSV Value
Remote Day of Month	{[PLC]CLOCK[2]}	Day GSV Value
Remote Hour	{[PLC]CLOCK[3]}	Hour GSV Value
Remote Minute	{[PLC]CLOCK[4]}	Minute GSV Value
Remote Second	{[PLC]CLOCK[5]}	Second GSV Value

The default Global Connection Maximum update rate of 1 second should be maintained.

CLOCK refers to a DINT tag array of length 7 within the PLC. The array should be populated through the use of the GSV WALLCLOCKTIME function within logic.

4.3.E - Other Global Connections

No other Global Connections are required for standard PanelView Plus 6 applications. Consult with the District prior to configuring additional Global Connections settings within the application.

4.3.F - MER Files

Only the current machine edition runtime file (.mer) may be stored on the PanelView. All older versions of the application should be removed and archived in the Districts Asset Centre.

Section 4.4 - Display Development

4.4.A - Display Type

“Replace” type displays shall be used for depicting process flow, measurements, and status. Replace type displays consume the least amount of memory and provide a simplified mechanism for closing the prior screen.

All onscreen functionality will be depicted within a single opened Replace type screen. This includes local display time, logged in user indication, the graphical depiction of the process, real time tag values and control measurements, and screen navigation. Common functionality will be repeated on each Replace type screen, as needed.

“On Top” display types shall be used for faceplates and other overlay graphics as required by the project. With the exception of faceplate graphics included as part of the standard template library, On Top display types should be limited within the project.

“On Top Cannot Be Replaced” display types shall not be used without prior approval from the District.

4.4.B - Display Name

Refer to the diagram in section 4.4E for additional clarity. Display names shall take the following format:

[AREA#][DISP#] - [AREA/PROC] - [DISPLAY]

Where:

[AREA#] – Arbitrary 2-digit number (not related to tag naming area), that groups common screens together in the application. For applications with only a single area, this value should be 01. Valid ranges are from 01 to 39.

[DISP#] – Unique number referencing a particular process or display within the area. Valid range is 1 through 9.

[AREA/PROC] – Up to a 10 character description for identifying the common grouping of screens referenced by the [AREA#] field. Use the abbreviations in Part IV Section 7 when applicable.

[DISPLAY] – Description identifying the display graphic referenced by the [DISP#] field.

Note: if the description exceeds 20 characters try shortening it by using standard abbreviations shown in Part IV Section 7.

Examples:

021 – FW – OVERVIEW

022 – FW – SOFTENERS

041 – DSP – OVERVIEW

044 – DSP – DSP STPTS

The display title shown in the upper left hand corner of each display shall use the same display name as outlined above.

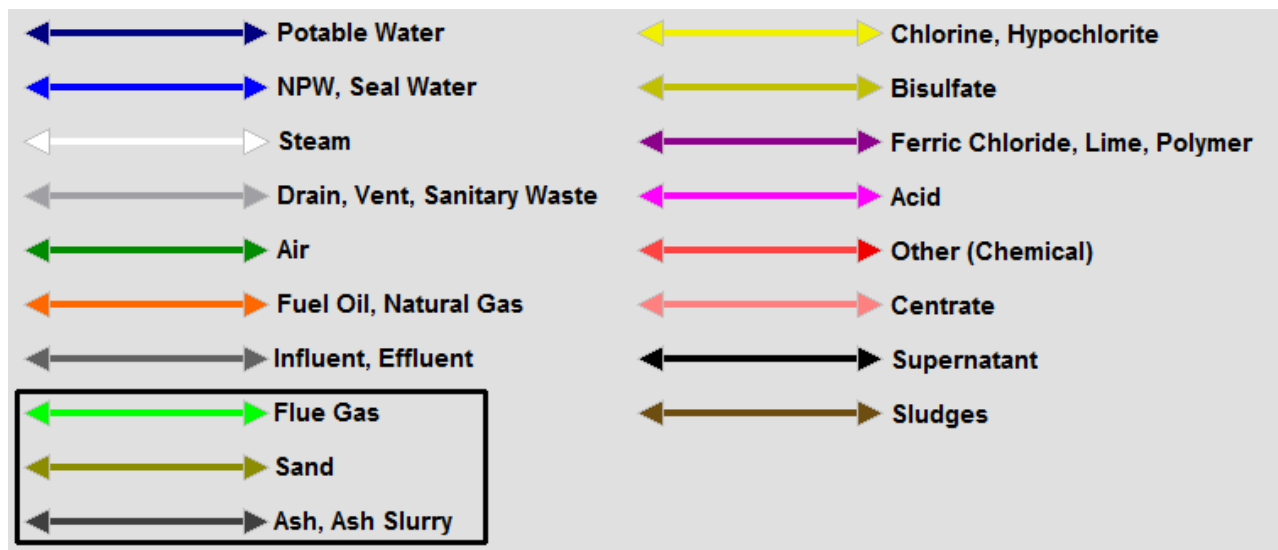
4.4.C - Color Standards

The following is a general guideline on the use of coloring object's and animation:

Background	Light Gray (Use Base Project Default)
Header Background, Nav and Other Display Buttons	Medium Gray (Use Base Project Default)
Process Piping	Reference figure below.
Status Animations (On/Off/Event/Fault)	Reference District Standard Section Part II Section 1.1
Numeric Display, Numeric Input Disabled	Light Gray Background, Black Font
Numeric Input Enable	White Letters, Black Background
Label and Desc Text	Black
Inanimate, Unknown, or Static Objects	Medium Gray, or Gray Shaded/Gradient as provided in FactoryTalk View ME Libraries

Process Piping

Standard process piping colors are shown below:



The District maintains an OIT graphic that contains the standard process piping colors, sizes, and process arrows for use with OIT applications. Developers should make use of these standard objects when at all possible.

Process piping should run either horizontal or vertical and connect at right angles. Piping drawn diagonally should be avoided.

4.4.D - Font

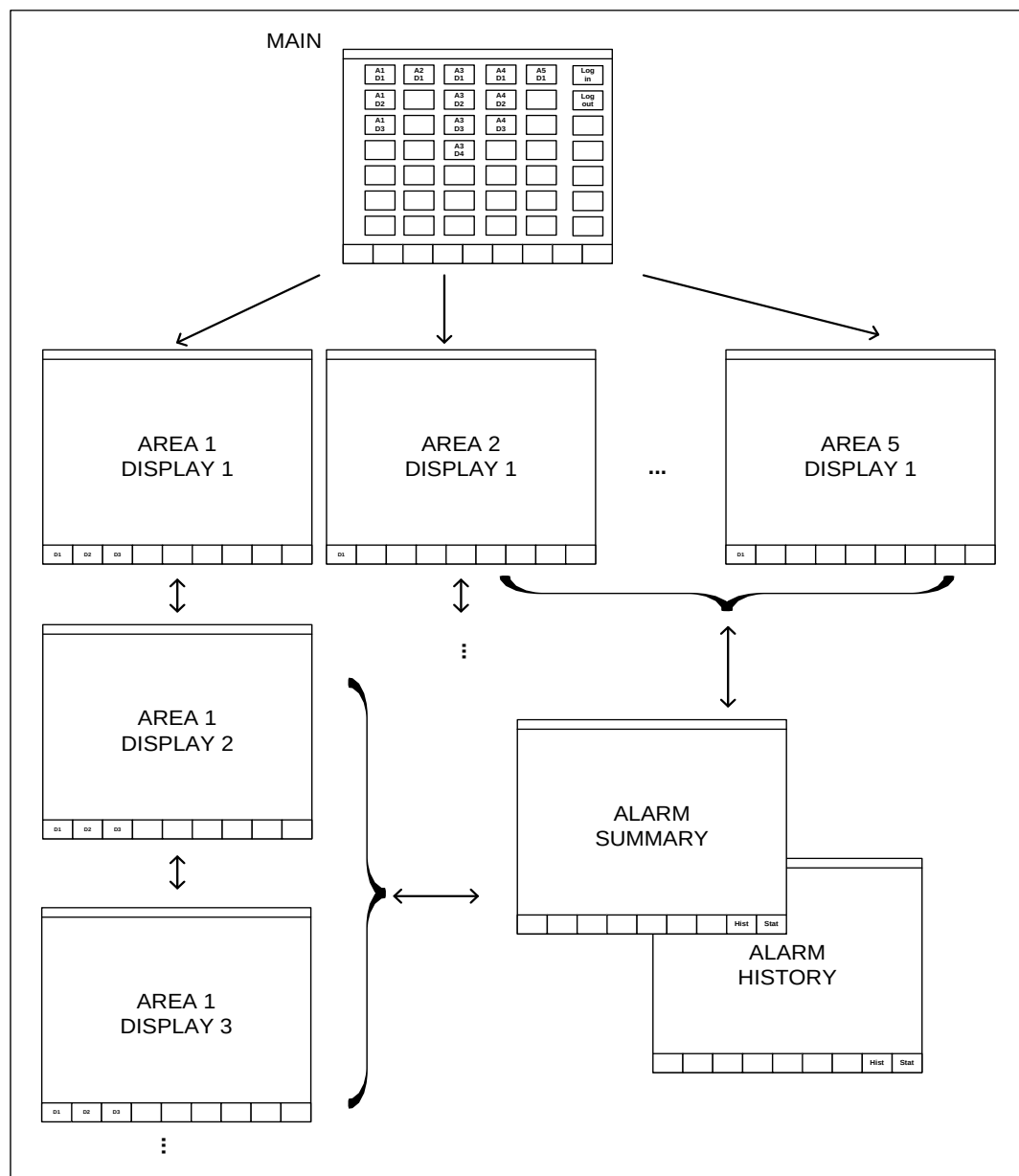
Labels, descriptions, numeric values, and other textual displays should all be a small sized yet clearly readable font, Arial style, black, and bold by default. For model 1250 and model 1500 PanelView Plus 6 (or current series) terminals, font sizes should be between 10-12. For PanelView Plus 6, Model 700, size 8-10 is acceptable.

For titles or headings within the graphic display or other text that requires greater attention, the text size may be sized slightly larger and underlined.

For navigation and other functional buttons, the text size 8 font, Arial style, black, and bold by default.

4.4.E - Navigation

PanelView applications should follow the navigation standard set forth within the base project example. The following diagram illustrates the standard “Row/Column” navigation approach:



Each “Column” of buttons represents a process area or equipment. The first “Row” button navigates to the specific area. The subsequent row buttons indicate what additional screens exist within that specific area. Only the first row of buttons has navigation functionality. The other screens are accessible from the bottom button bar, only after navigating to the overview screen (or similar), from the Main menu screen.

Note: The last column of buttons should be reserved for any system configuration or system settings screens. These screens will be accessible only when the user is logged in with proper security.

Main

Each PanelView Plus 6 project will contain a main screen configured as the initial starting graphic when the application boots. The Main screen will contain buttons to navigate to an overview or primary screen for each process area in the project. Additionally, the Main screen will contain login/logout functionality, as well as a “Shutdown” Button to access the terminals native configuration mode for those logged in with proper access rights.

Display Areas

All displays within a configured area will contain a similar navigation bar placed at the bottom of the screen. The bar will contain a button to navigate back to the main screen as well as buttons to navigate to all configured screens within that area. In order to navigate to a different area, the user will have to navigate back to the main screen.

It is encouraged to use an area overview screen as the first display for the area.

With the exception of calling faceplate and other On Top display types, no other “Goto Display” Buttons may be placed within the graphic.

Alarm Summary, History, and Status

All screen displays must contain a link to the alarm summary screen. This makes the alarm summary accessible from anywhere within the application. The alarm summary screen shows the currently active and unacknowledged alarms. Closing the alarm summary screen returns the user back to the last viewed process display screen.

From the alarm summary, the user may navigate to the alarm history screen and, if logged in with proper rights, the alarm status screen. Closing these screen returns the user back to the alarm summary, from which they can return back to the last viewed process display.

Keypad Usage

K-Keys are reserved for full-page navigational purposes within the application. All navigation buttons must be assigned a unique K-Key designator for navigating through the application using the keypad.

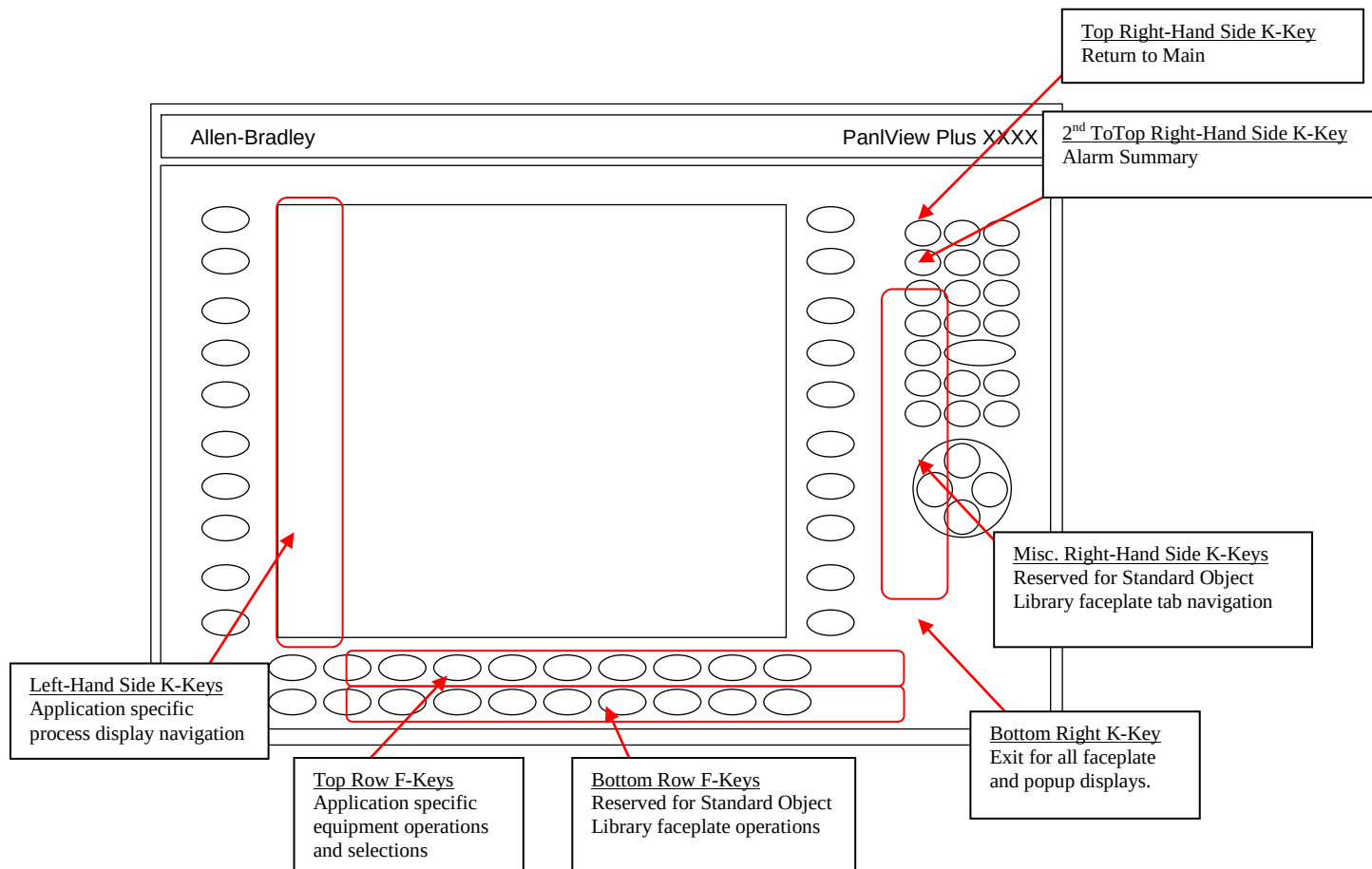
The navigation button label should contain the assigned K-Key, preferably on the second line of the label, in parentheses.

F-Keys are reserved for operation type functions such as device START/STOP, mode selection, setpoint entering, etc. The top row of F-Keys should be used to open the objects on the screen, while the second row of F-Keys should be reserved for actions on the object faceplate. This technique will prevent accidental “double-clicking” of a key, which could result in undesired action.

K-Key assignments should only be used for navigation of full screen displays. Faceplate and other popup displays shall use F-Key assignments.

Key Assignments

The assignment of K- and F-Keys to objects within an application follows a standardized approach that must be observed in order to promote consistency across PanelView Plus 6 models. Since the number and location of similar keys differs between PanelView Plus 6 model sizes, the keypad assignment for routine operations (return to Main, close faceplate, etc) will be assigned a key based on that key's location on the face of the PanelView and not necessarily by a consistent key number. The following diagram illustrates this standard approach:



The following tables list standard key pad functions for each PanelView Plus 6 type:

PanelView Plus 6, Models 1250/1500

Key Assignments on Typical Process Area Display	
Key	Function
K1-K10	Navigation between displays within a process area (<u>application specific</u>)
K11	Return to Main Screen, accessible on all screens
K12	Displays Alarm Summary Screen
K13-K14	(No function)
K16-K19	Navigation between faceplate tabs on active faceplate
K20	Closes faceplates, Diag., Info., Alarm pop-ups, or any On-Top display

F1-F10	Equipment operations/selections, device faceplate (<u>application specific</u>)
F11-F20	Faceplate operations on standard library objects
Key Assignments on Main Screen Functions	
K1-K10	Navigation between process areas (<u>application specific</u>)
K11	(No function)
K12	Displays Alarm Summary Screen
K13	Displays Trend Overview Screen (Navigation to Trend Area)
K14	Displays Maintenance Overview Screen (Navigation to Maintenance Area)
K15	PanelView Configuration Access (Requires Login)
K16-K20	(No function)
F1	User Login
F2	User Logout
F3-F20	(No function)

For PanelView Plus 6, Model 1250 and 1500 terminals, integrators typically will assign K1-K10 and F1-F10 to objects within their specific application. For screens with more than 10 objects requiring assignment, keys F11-F20 may be used, starting with F11. Assigning other keypad assignments to objects should be avoided as they are reserved for standard functions.

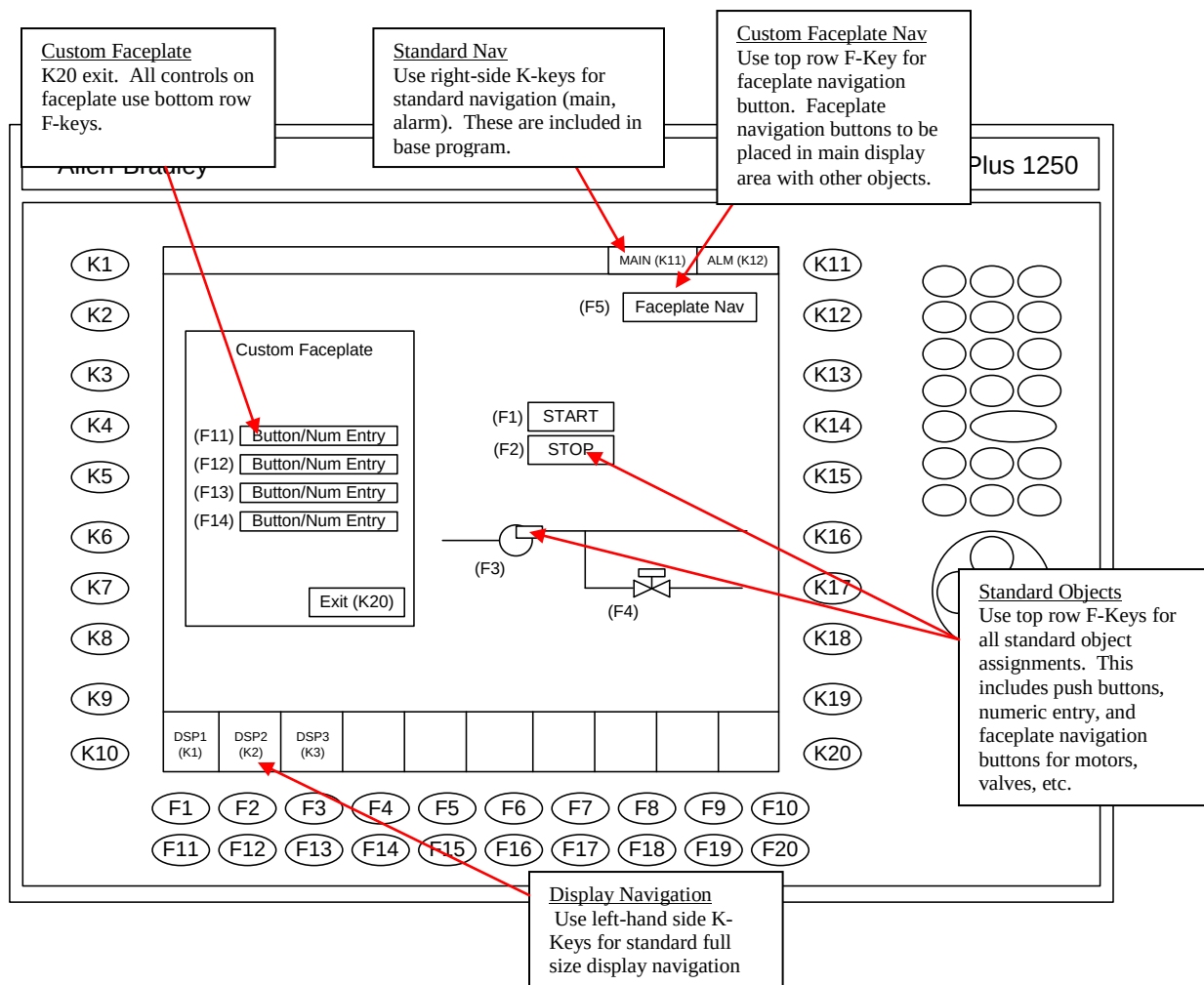
PanelView Plus 6, Model 700

Key Assignments on Typical Process Area Display	
Key	Function
K1-K6	Navigation between displays within a process area (<u>application specific</u>)
K7	Return to Main Screen, accessible on all screens
K8	Displays Alarm Summary Screen
K9-K11	Navigation between faceplate tabs on active faceplate
K12	Closes faceplates, Diag., Info., Alarm pop-ups, or any On-Top display
F1-F5	Equipment operations/selections, device faceplate (<u>application specific</u>)
F6-F10	Faceplate operations on standard library objects
Key Assignments on Main Screen Functions	
K1-K6	Navigation between process areas (<u>application specific</u>)
K7	(No function)
K8	Displays Alarm Summary Screen
K9	Displays Trend Overview Screen (Navigation to Trend Area)
K10	Displays Maintenance Overview Screen (Navigation to Maintenance Area)
K11	PanelView Configuration Access (Requires Login)
K12	(No function)
F1	User Login
F2	User Logout
F3-F10	(No function)

For PanelView Plus 6, Model 700 terminals, integrators typically will assign K1-K6 and F1-F5 to objects within their specific application. For screens with more than 5 objects requiring assignment, keys F6-F10 may be used, starting with F6. Assigning other keypad assignments to objects should be avoided as they are reserved for standard functions.

Illustration of Key Assignments

The following diagram illustrates an example PanelView Plus 6, Model 1250 graphic display and depicts standard K and F-Key assignments:



4.4.F - OEM Screens

Integrators may include displays that provide information critical for system testing and commissioning (such as tuning PID loops). These displays should use an [AREA] assignment of 30 and an [AREA/PROCESS] description of “OEM”.

Examples include:

301 – OEM – Setpoint Limits

302 – OEM – Drive Settings

OEM displays are never used for normal operation and any pertinent information must be made available on District accessed displays. Access to OEM screens must be removed after commissioning.

Other than the naming convention above, OEM graphics are not subject to the District standard. Standard navigation to OEM screens is provided in the base application and should be used when possible.

Section 4.5 - Tag References and Usage

4.5.A - Direct Reference Tags

All references to ControlLogix tags made within a project shall be made using Direct (Device) Reference.

Direct reference tags are used to maximize the runtime performance of tag read/write operations, to minimize tag memory consumption, and to remove the added HMI layer for configuration of basic display read and write operations.

4.5.B - HMI Tags

HMI tags in general should not be used to link application elements (tag displays, trends, data log models, etc.) with ControlLogix controller tags. Instead, direct reference tags should be used wherever possible.

Section 4.6 – Security

New applications submitted for approval shall have a single Default user account set with full privileges. Additional user accounts and passwords will be configured onsite, during the commissioning of the system, from a District provided engineering laptop. This will insure that the correct user accounts and associated District FactoryTalk Directory security settings will be deployed.

The remainder of this section describes the final security settings. Contractors should develop applications/screens that will make use of the security privileges and account profiles detailed below. Refer to section 4.6.C for security usage instructions.

4.6.A - User Groups and Accounts

A standard set of user groups will be provided by the District for use within each PanelView Plus 6 application. One of more accounts under each group may be assigned to each PanelView application. The standard user groups are listed below:

- Default (View Only)
- Operator
- Maintenance
- Supervisor
- Configure

4.6.B - General Account Privileges and Restrictions

The bulleted list below outlines security codes and runtime account privileges for each user group that should be anticipated for the final application.

Default (View Only) – Security Code A

- Can view all process monitoring screens
- Unable to enter values or change setpoints
- Unable to open control object faceplates
- Unable to acknowledge alarms
- Unable to access PanelView terminal settings

The default account is provided for leaving the PanelView in a safe and secure state. The user can navigate through the application and monitor process values. They are unable to control equipment or setpoints or otherwise impact the running process.

Operator – Security Code A, B

- Can view all process monitoring screens
- Able to open and operate object faceplates for the purpose of device mode selection and manual control
- Able to view and acknowledge configured alarms
- Unable to enter values or change setpoints for process control

- Unable to enter or change configuration type values on faceplate objects (e.g. alarm limits)
- Unable to access PanelView terminal settings

Operator accounts are provided for basic operator control and monitoring. Operators may typically view all process and faceplate data, but are unable to change process configuration type values. When operator set point manipulation is required, it must be provided at this security level.

Maintenance – Security Code A, B, C

- Can view all process monitoring screens
- Able to open and operate object faceplates for the purpose of device mode selection and manual control
- Able to view and acknowledge configured alarms
- Able to access maintenance specific screens for diagnostic information
- Unable to enter values or change setpoints for process control
- Unable to enter or change configuration type values on faceplate objects (e.g. alarm limits)
- Unable to access PanelView terminal settings

Maintenance accounts take all of the operator's abilities and add access to maintenance specific screens for extended diagnostic features.

Supervisor – Security Code A,B,C,D

- Can view all process monitoring screens and additional process setpoint/limit screens as configured
- Able to open and operate object faceplates for the purpose of device mode selection and manual control
- Able to view and acknowledge configured alarms
- Able to enter values and change setpoints for select process control points
- Unable to enter or change configuration type values on faceplate objects (e.g. alarm limits)
- Unable to access PanelView terminal settings

Supervisor accounts have limited added privileges over operator accounts. Supervisors can access and change select process control setpoint limits that are deemed appropriate by PLC programmers.

Configure– Security Code A,B,C,D, E

- Can view all configured screens
- Able to open and operate all provided objects on control faceplates
- Able to view and acknowledge configured alarms
- Able to enter values and change setpoints for all provided process control points
- Able to enter and change configuration type values on faceplate objects (e.g. alarm limits)

- Able to access PanelView terminal settings

Configure accounts have unrestricted access to the PanelView runtime application. Configure accounts should be held only by District engineers for runtime editing of template block operation as well as configuring the PanelView Plus terminal settings.

4.6.C - Configuring Security Access

The Global Object Template library is designed to meet most application runtime security needs. For example, during runtime, template objects with faceplates require Operator or equivalent privileges to access. Faceplate configuration type settings similarly require Configuration level access privileges.

For additional security needs, the application developer should make an attempt to segregate restricted controls or settings on screens accessible only to those with proper security levels. The use of visibility animation on navigation buttons is the preferred method by the District. Visibility animation should be evaluated using the *CurrentUserHasCode()* function.

The Security Code field part of Display Settings should not be used as a means to restrict access to displays. The default setting (* - all users) should be retained for consistency.

4.6.D - Account Login/Logout

All user accounts with the exception of View are password protected and require the user to provide both a username and password when logging in.

The “Logout” option on the main screen will logout the current user and login to the default (View only) account. In order to switch to an operator, supervisor, or configure account, the user will have to select the “Login” option on the main screen.

New PanelView projects are prohibited from providing other user account control functions other than the default login/logout provided on the Main screen in the base project. Set password functions for logged in users during runtime is prohibited.

4.6.E - Auto Logout

Each PanelView Plus 6 application should be configured for automatic logout after a period of inactivity. This setting is configured in the Project Settings dialogue and is referenced in Section 04.3.C - Project Runtime Settings of this document.

Section 4.7 – Alarming

4.7.A - Trigger Type

All configured alarm messages within the PanelView application shall use the Bit trigger type as opposed to the Value and LSBit methods. The Bit trigger method aids in reducing the number of alarm trigger tags, which can lead to optimized communications overhead and memory usage within the running program.

4.7.B - Trigger Tag

Developers should use one or more ControlLogix DINT tags to serve as a Boolean array for alarm trigger. Applications should be configured using a single trigger tag of type DINT or DINT array (DINT[X], where X is the array length) named:

PV_ALARM

Where advantageous the developer may choose to group alarms into one or more areas, with unique trigger tags with the following format:

PV_ALARM_[AREA]

Where [AREA] represents the area or equipment pertaining to the alarms in the trigger.

4.7.C - ControlLogix Trigger Routine

PanelView alarming should be organized in the ControlLogix processor within one or more dedicated routines. Ladder routines are preferred.

Alarming bits on the trigger tag should not be latched, but instead only held active as long as the alarm is active. Alarm messages within the PanelView application are generated when the trigger bit value transitions from 0 to 1.

No PanelView to PLC acknowledgment handshaking should be used.

4.7.D - Trigger Label

The label for each trigger tag should carry over the name of the trigger tag name defined in ControlLogix for consistency and simplicity.

4.7.E - Message Guidelines

Each alarm trigger should generate a unique message that is concise yet descriptive. Process area and equipment naming shall remain consistent across OIT, PLC and HMI platforms. For PanelView applications with similar alarm sets for more than one set of equipment or process train, the alarm message shall be prefixed with the equipment or train number to be followed by the alarm in the message.

Several alarm message examples are shown below for a raw water softener skid with three units:

Part V – CLX/WW/PV+	V-100	Revision 2.0.1
---------------------	-------	----------------

“Softener #1 Conductivity High”
“Softener #2 Conductivity High”
“Softener #2 Differential Pressure High”
“Softener #3 Conductivity High High”

Use of embedded variables in the alarm message shall not be used.

Alarm messages must fully match across both the HMI and OIT displays as well as the comments provided in the tag description in the PLC.

In general, the PLC programmers shall decide the alarm message, place the message as part of the bit field comment of the alarm tag, and provide the same alarm message for OIT and HMI developers to configure.

4.7.F - Advanced Settings

Default values for the advanced alarm settings as defined within the base PanelView project shall be used.

The default advanced alarm settings values are detailed below:

Display	[Alarm] (PV default)
History	128
Hold Time (ms)	250
Max Update Rate (seconds)	1
Optional Connections	(None)

Prior approval from the District is required before a specific application may deviate from the advanced settings.

4.7.G - Alarm Displays

The default alarm display shall be used in all PanelView applications. This display, by default, will open a pop-up when a new alarm is generated and displays an alarm banner object.

Active and/or unacknowledged alarms may be viewed from the Alarm List object displayed on the Alarm Summary graphic, which is accessible via navigation from all screens.

A historical log generated alarms is accessible from a similar Alarm List object displayed on the Alarm History graphic. This graphic is accessible from the Alarm Summary graphic.

The Alarm Status graphic displays configuration and diagnostic information regarding the alarm setup for the PanelView application. Alarm Status information is only accessible to user accounts with Maintenance level or higher credentials.

No other alarm objects, including alarm lists or banners, should be created within the PanelView application.

4.7.H - Alarm Filtering

Alarm filtering should not be incorporated into any alarm object within the PanelView Plus 6 application. The Alarm Summary, Alarm History, and Alarm Status displays by default must show all configured alarms.

Section 4.8 – Trending

4.8.A - Trend Areas

Areas 10 – 19 of the standard PanelView application are reserved for historical trend screens. This area provides a central location where any user can navigate to view all configured trends for a given application.

Navigation through the trend screen area follows in a similar manner as process displays described before. Display 101- Trend Main displays a directory of configured trends screens from which the user during runtime may navigate between trend areas. When inside a particular trend area, the user may navigate between trend displays in that area or return to the main trend directory.

Trend screen naming should follow the standard PanelView display naming conventions outlined 4.4.B. The Area/Process and Display description fields in the display name are up to the developer's choosing.

4.8.B - Trend Area Template

Developers should make use the trend template graphic provided with the base PanelView application for configuring trends within the trend areas. No other process object or other display information should appear on these screens. Only one trend should appear on each screen.

4.8.C - Other Trends

Aside from trends configured in the trend area, trends may also be configured and placed on process displays as required. These trends must use the built in ME Studio trend object, and should follow trend standard colors and attributes set forth within this document.

4.8.D - Trend Colors

The colors within the example trend in the base project shall be used for all trending with the application. The color standards are listed below:

Background	White
Text Color	Black
Grid (X,Y axis)	Dark Gray
Pens, in increasing order	(See below)

Pen colors for a single control loop trend shall follow the table below:

Process Variable (PV)	Green
Setpoint (SP)	Blue
Control Variable (CV)	Yellow

For all other trends, use of the default trend object pen colors (in increasing order: blue, light green, red, magenta, black, dark green, yellow, light blue) is generally preferred. Otherwise, the

pen colors are at the discretion of the application developer, in which case pen colors may be chosen to match process line colors, etc. Pen colors shall be chosen that are unique between pens and are clearly distinguishable against the white background.

4.8.E - Refresh Rate

The maximum refresh rate that may be chosen for a trend is 2 seconds. In general, a refresh rate of 2 seconds shall be chosen for trending process data. The developer may select a slower refresh rate based upon the process, the time span, etc.

4.8.F - Trend History

The application should provide historically log all trended values for a period of 12 hours.

4.8.G - Maximum Pens per Trend

The developer shall limit the number of pens per trend to 8 or less.

4.8.H - Other Trend Settings

In general, developers shall try to use the existing trend examples in the base project as a guideline for configuring trends in their application.

The following list details general trend settings:

GENERAL	
Chart Style	Standard
Chart Update Mode	Automatic
DISPLAY	
Chart Radix	Decimal
Data Point Connection	Connect Data Points
Display Milliseconds	Unchecked
Display Pen Icons	Checked
Font	Arial, 8, Bold
Scrolling	Allow
Scroll Mode	Continuous
Buffer for Extra Data	2000
PENS	
Width	1
Marker	None
X-AXIS	
Display Scale	Checked
Display Gridlines	Checked
Grid Lines	4 Major, 0 Minor
Y-AXIS	
Isolated Graphing	Unchecked
Display Scale	Checked
Display Grid Lines	Checked
Grid Lines	4 Major, 0 Minor
Scale Options	Select Each Pen On Independent Scale

Section 4.9 - Data Logging

4.9.A - Number of Models

Applications should include a single data log file to collect all pertinent data. Only one data log can run at any given time.

Use of data log models is required to provide trend history for all configured application trends.

4.9.B - Maximum Data Points

The maximum data points must be set to achieve a 12 hour history of logged data for all configured trends.

4.9.C - Logging Path

The system default logging path should be used for all data log models.

4.9.D - Log Triggers

Each log should be set up to trigger periodically at an interval no faster than 2 seconds.

4.9.E - Tags In Model

All tags within the model must be configured as direct reference tags. Tags within the same model may be polled from more than one PLC. There are no limits to the number of tags within each model.

Section 4.10 - IO Diagnostic Screens

4.10.A - Overview

All PanelView Plus 6 applications are required to provide displays depicting PLC hardware health and status information. These screens are built using standard PLC module diagnostic global objects distributed by the District to provide maintenance personnel with real time module channel status and diagnostic information. These screens are designed provide view only information and are primarily intended for maintenance and troubleshooting activities.

4.10.B - Screen Requirements and Architecture

The following depicts screen quantity and requirements:

Maintenance Overview

The Maintenance Overview display is a single screen that is intended to summarize the architecture of the viewed PLC system. The display graphically shows the number of and type of PLC racks, OITs, and network types (Ethernet, Modbus, etc.). Objects on the Maintenance Overview graphic are static; they are not animated and do not provide status information.

The District standard DIAGNOSTIC library contain symbols specific for generating the Maintenance Overview display.

PLC Rack Displays

A separate maintenance display should be created for every PLC rack contained within the architecture. Each display will show a single PLC rack detailing the chassis size, module configuration, and current module health (OK, FAULT).

The District standard DIAGNOSTIC library contains PLC rack and chassis elements as well as global object module symbols for use in generating the rack displays. Module symbols require configuration.

Module Faceplate Displays

Specific module information is provided on faceplates incorporated into the standard DIAGNOSTIC symbols. Faceplates display module and loop information including channel state (on/off, analog %), channel faults, device tag (from P&IDs), device description (from IO list), device units (analog inputs), and other relevant module configuration settings.

Most diagnostic templates read RSLinx Enterprise and ControlLogix module defined tag data to gather diagnostic information. Generally no ControlLogix AOI or programming is required.

If the diagnostic template for a specific module is not available in the District's library, the contractor shall create a new template, using one of the existing templates as a model.

4.10.C - Area and Navigation

Areas 20 – 29 of the standard PanelView application are reserved for Maintenance and Diagnostic type displays. Typically, only one a single area (20) is required for maintenance screens. The total number of screens will, at a minimum, consist of:

- 1 for the Maintenance Overview
- 1 screen per PLC rack (Processor and Remote IO racks)

The main maintenance screen (200 – MAINTENANCE OVERVIEW) should contain navigation links to each PLC rack screen.

Use the following display names as applicable:

200 – MAINTENANCE OVERVIEW
201 – MAINTENANCE – RACK 0
202 – MAINTENANCE – RACK 1
203 – MAINTENANCE – RACK 2...

Section 4.11 - Standard Control Templates

4.11.A - Global Object Templates

All PanelView controls that provide read/write functionality to ControlLogix tags must make use of the District Standard Global Objects Template library. Each template object is preconfigured to match on a one-to-one basis with ControlLogix AOI's.

For a complete list of the objects and instructions on their proper use, refer to NEORS D Standard Object Library User Manual.

4.11.B - General Usage Requirements

All global template object expressions and animations are pre-linked to the required member of the corresponding ControlLogix AOI tag. PanelView Plus 6 programmers should not try to adjust or change field values or animation settings with the template object itself.

Object instances are created using a drag and drop method onto the desired graphic. Each instance requires at a minimum the following fields, generally presented in the following order:

Discrete Valve and Motor Objects:

Parameter	Field	Description
#1	Tag Address	PLC tag (direct reference)
#2	Tag Name	Device Tag for display on faceplate
#3	Device Desc	Device/Tag description for display on faceplate
#4	Keypad	Keypad Assignment for display next to object
#4-#9	Intlk Desc	Interlock 1 – 5 descriptions for display on faceplate

Analog Objects

Parameter	Field	Description
#1	Tag Address	PLC tag (direct reference)
#2	Tag Name	Device Tag for display on faceplate
#3	Device Desc	Device/Tag description for display on faceplate
#4	Eng Units	Units for display on faceplate
#5	Keypad	Keypad Assignment for display next to object

Discrete Objects

Parameter	Field	Description
#1	Tag Address	PLC tag (direct reference)
#2	State 0 Text	Text displayed when discrete value is 0 (clear)
#3	State 1 Text	Text displayed when discrete value is 1 (active)
#4	Fault Text	Text displayed when fault active

PID/PIDE Objects

Parameter	Field	Description
#1	Tag Address	PLC tag (direct reference)
#2	Tag Name	Device Tag for display on faceplate
#3	Device Desc	Device/Tag description for display on faceplate
#4	Eng Units	Units for display on faceplate
#5	Keypad	Keypad Assignment for display next to object

Diagnostic Module Objects

Parameter	Field	Description
#1	Tag Address	PLC tag (direct reference, references module tag)
#2-??	Channel Tag	Channel device tag for display on faceplate

4.11.C - Global Object Default Values

The PanelView Plus 6 project should retain the original settings for the Global Object Default Values as provided in the base project. The required settings are as follows:

LinkAnimation default: Link with expressions

LinkConnections default: True

LinkSize default: True

Retaining these settings will ensure that the global objects work correctly and are used in the manner that they were intended.

SECTION 5 - DEVICELOGIX PROGRAMMING

Section 5.0 - Introduction

DeviceLogix Smart Component Technology integrates logic-solving capability into I/O, motor starters, push buttons, and other control components, providing higher-performance and lower-cost distributed control. A DeviceLogix capable device operates as a slave device on a DeviceNet network. You can enable a logic operation using the DeviceLogix Editor to provide local control over outputs on a device. These logic operations are limited to:

- Boolean
 - o AND, OR, XOR, NAND, NOR, XNOR
- Bistable
 - o RS LATCH, SR LATCH
- Counters / Timers
 - o UP CTR, UP/DN CTR, PULSE TMR, ON DELAY TMR, OFF DELAY TMR

Section 5.1 - Programming for DeviceNet

5.1.A - General

DeviceLogix is a stand-alone Boolean program which resides within the DeviceNet component. RSNetworx for DeviceNet is required to program the device with this technology. It is important to note that the DeviceLogix program will only run if the logic has been enabled, which can be done within the Logic Editor of RSNetWorx for DeviceNet.

5.1.B - Software

The below software packages are required to enable the DeviceLogix program applications.

- RSNetWorx for DeviceNet
- RSLinx Classic

RSNetWorx for DeviceNet is a 32-bit Windows application program that allows you to configure DeviceNet devices. Using a graphical or spreadsheet representation of your DeviceNet network, you can configure all devices on the network.

5.1.C - Revisions

The District requires all new DeviceLogix application programs to use the same version of RSNetWorx that is currently in use at the NEORS. Verify with the District project manager which program version to use before starting any new applications.

Section 5.2 - Standard Program Structure

5.2.A - Logic Routines

DeviceLogix allows for function blocks or ladder logic programming. However, the District requires all DeviceLogix programming to be done in ladder logic for ease of maintenance.

5.2.B - Node Address

Each device on a DeviceNet network must have a unique node address which can be set to a value from 0 to 63. Address 0 is always reserved for the master device (Scanner) and node address 63 should be left vacant for introduction of new slave devices.

5.2.C - Network Communication Speed

The data rate of all the devices connected to the network is user-configurable, but ultimately limited by the distance of the DeviceNet cable. For consistency purposes, the network speed should be set for 125K baud.

5.2.D - Commenting Logic

All RSNetWorx programs must be accurately commented. The first rung comment should describe the purpose of the logic, with following rungs adding detail as necessary. Commenting includes all program titles, all program logic, and all program elements.

5.2.E - EDS Files

RSNetWorx for DeviceNet software can access only those DeviceNet devices that have been registered. You must use the EDS Wizard for registering EDS files for unknown devices, as well as installing EDS files.

The District requires the contractor to supply EDS files for all new devices.

Section 5.3 - Standard Program Naming Conventions

5.3.A - RSNetWorx Program Naming Convention

The RSNetWorx application program will be stored in the District's FactoryTalk Asset Centre system. For this reason it needs to follow a standard naming format. The RSNetworx program name applies to a network of devices, and as such should account for the common name of the area in which that network exists.

The general convention to be used for any new program should take a "drill down" approach:

Process Area → Network Area → Sequential Numerical Designator

The name must also include a prefix that indicates the NEORS D plant and process area. This information is provided in Part 2, Section 9 of the automation standard.

The format is represented in the following:

[Plant][ProcessArea]_[Network Area Name]_[Number]

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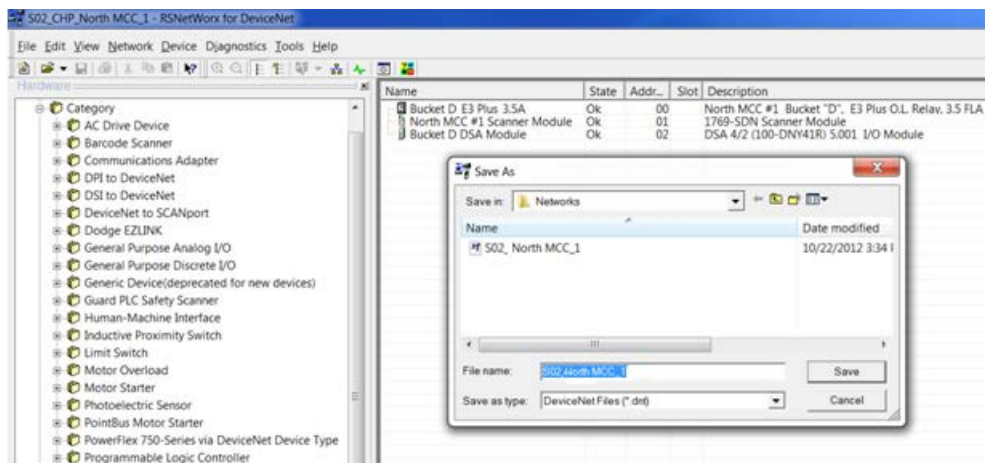
The network name should provide enough detail to clearly understand what devices are serviced by the program. Any abbreviations must comply with the NEORS D Process/Equipment Abbreviation, provided in Part 2, Section 4 of the automation standard.

Example: North MCC #1, Southerly Cooling Water Pump and others, located in the access building #1. The file name becomes “S02_ North MCC_1”

Where

- S=Southerly
- 02 = the process area (access bldg 1), per the lists provided in Part 2, Section 9.
- North MCC is the common name of equipment area, and so becomes the network area name
- “1” is the parallel equipment designator, or train number of the device.

See example of the RSNetWorx file name screen shot below, where the file name is being set through the “Save As” function.



5.3.B - Device Naming Convention

The device name is set under the “General” tab. The device name should be created in a consistent manner, and provide adequate detail. To aid in this, the following format should be utilized:

[Equipment Label]_[Device Type]_[Detail Info]

Equipment Label - Physical equipment tag. Use physical location if no tag is available

Device Type – The DeviceNet device; E3 overload, DSA module, etc.

Detail Info – additional details relevant to the device type.

- E3 devices should include the full load amps
- DSA devices should include the details of the I/O

- o Interlocks, permissive, etc

Example: North MCC #1, Bucket D, E3 Plus Overload relay

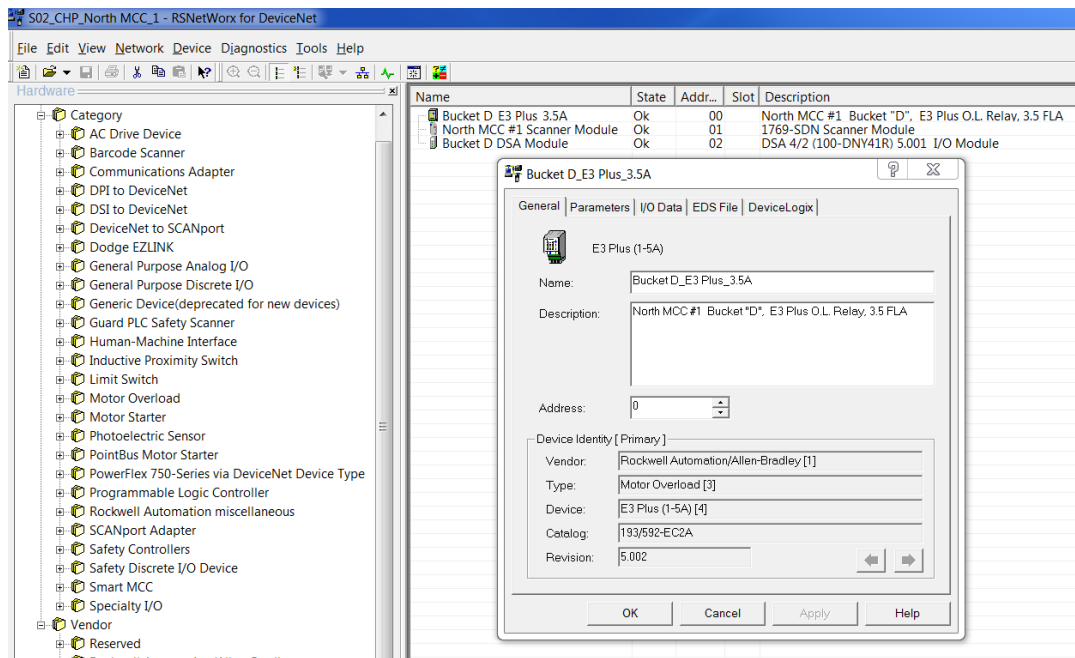
- Name = Bucket D_E3 Plus_3.5A
 - o FLA = 3.5A

Example: North MCC #1, Bucket D, DSA I/O device

- Name = Bucket D_DSA_Interlock
 - o I/O is associated with motor interlocks

It is also recommended that the description field be utilized for additional details. When possible, the asset number or property tag should be included in the description.

See example of the Device naming in the screen shot below, which is from the RSNetWorx for DeviceNet program, device properties.

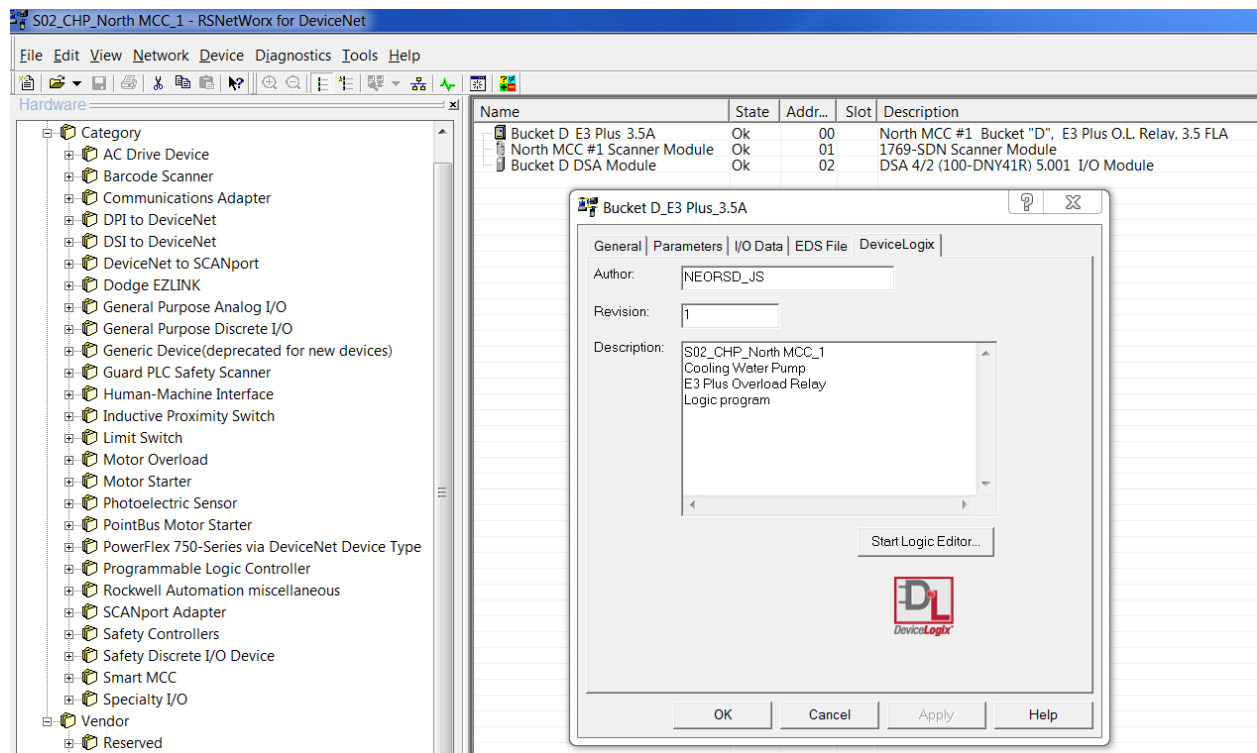


5.3.C - DeviceLogix Program

When creating a DeviceLogix program, all users should fill in the following information:

- Author - Company/Integrator_ Initials
 - o Example: NEORS D_JS; NEORS D employee John Smith
- Revision - Originating at "1" and going up sequentially. Note: this is not tracked.
- Description - Brief description of process, equipment and function. Include project number if applicable.

See example of the DeviceLogix properties screen shot below, which is from the RSNetWorx for DeviceNet program, device properties, DeviceLogix tab.



Section 5.4 - Standard Ladder Editor Commenting Conventions

5.4.A - Ladder Commenting

All Ladder Logic rungs must be commented to identify the function/purpose of the rung.

- The first rung of the program should outline the purpose of the overall logic, along with the function of the first rung.
- The additional rungs must be commented with their specific purposes.
- Each logic element/operand must be commented to identify its purpose.
- Include tag labels when possible.

See example program below.

